Slope Stability Investigation Report

Amended Reclamation Plan
CalPortland Oro Grande Mine, ID #91-36-0023
San Bernardino County, California

February 20, 2019
Terracon Project No. CB185153

Prepared for:
CalPortland Company
Glendora, California

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February 20, 2019

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Re: Slope Stability Investigation
CalPortland Oro Grande Mine
San Bernardino County, California
Terracon Project No. CB185153

Dear Mr. Martin:

Attached herewith is the slope stability investigation report for the amended reclamation plan for the CalPortland Oro Grande Mine located in San Bernardino County, California. Our scope of services addresses new quarry slopes in the New Original Canyon Quarry (proposed), the Sparkhule Quarry, and the Superior Quarry. We also address various overburden stockpile configurations across the property, including within the Shay-Klondike Quarry. The Shay-Klondike, Mack's Peak and Q2 quarries are designed to be backfilled for reclamation. Highwall slopes in these quarries will be buttressed by backfill material; therefore, slope stability investigation is not required.

This report was based upon a scope of services generally outlined in our proposal, dated January 4, 2019, and other written and verbal communications.

We appreciate this opportunity to provide geotechnical services for this project. If you have questions or comments concerning this report, please contact this firm at your convenience.

Sincerely,
Terracon Consultants, Inc.

John S. McKeown

John S. McKeown, E.G. Senior Geologist

JMc/JJM:lb

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Amended Reclamation Plan
CalPortland Oro Grande Mine
CA Mine ID #91-36-0023
San Bernardino County, California
Terracon Project No. CB185153
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1.0 INTRODUCTION

This firm has prepared a slope stability investigation for the proposed amended reclamation plan for the CalPortland Oro Grande Mine in San Bernardino County, California. The County of San Bernardino-approved reclamation plan (84M-009) is dated June 16, 2003. The mine is developed in several quarries that primarily utilize the Paleozoic carbonate units. Existing quarries include Sparkhule, Mack's Peak, Original Canyon and Shay-Klondike. Our services included geologic mapping and data collection, sampling and testing of stockpile fills, and evaluation of kinematic and global slope stability for proposed rock and fill slopes as outlined in our proposal dated January 4, 2019. The purpose of our evaluation was to characterize the anticipated stability conditions of proposed reclamation slopes to be created in the New Original Canyon Quarry, Superior Quarry, Sparkhule Phases I and II, and various stockpile areas of the mine site. Information from prior investigators and documents provided was also utilized for this evaluation.

The information and recommendations herein apply to slopes proposed according to the Revised Reclamation Plan (84M-009) dated March 2018.

The approximate location of the project area is shown on the attached Site Location map. The results of our evaluation, together with our conclusions and recommendations, are presented in this report.

The evaluation of existing conditions is not within the scope of geologic/geotechnical reporting for a proposed mine reclamation. Existing conditions are addressed by the annual inspection process.

2.0 SCOPE OF SERVICES

We performed a slope stability investigation to address the amended reclaimed slope configurations to be formed in the various metasedimentary and intrusive rock units and stockpile fill materials and provide recommendations for adjustments required for stable slopes according to SMARA. Planned slope configurations were provided in a plan dated January 9, 2019, that includes sections for Sparkhule, Shay-Klondike/Mack's Peak/Original Canyon and Sparkhule Final Double Bench. Geologic field reconnaissance and geologic mapping of existing quarry slopes and adjacent areas were conducted by an engineering geologist from this firm in January 2019 in coordination with Ms. Julia Spears of CalPortland. Stereoscopic aerial photographs and data from prior mapping studies were examined. We utilized pertinent data from prior reports and investigations as appropriate.

We established the strength characteristics of rock materials based on our database of UCS tests of similar materials and slope stability application-based utilities.

We performed kinematic evaluation of characteristic geologic structure using stereonet plots and screening criteria to identify potential for various failure modes.

We also performed whole-slope global stability analyses of the tallest rock and stockpile slope configurations (representative) for static and seismic conditions in the amended slope areas. Stockpile materials strengths were determined from bulk samples collected from an existing stockpile adjacent to the Sparkhule quarry. The locations of sampling are shown on the Site Plan.

The results of mapping and analysis, our findings of suitability of the proposed slope configurations, and recommendations for modifications of slope geometry, where warranted by analytical results, are presented in this report.

The Shay-Klondike, Mack's Peak and Q2 quarries are designed to be backfilled for reclamation. Highwall slopes in these quarries will be buttressed by backfill material; therefore, slope stability investigation is not required.

3.0 PRIOR INVESTIGATIONS

A report by Bowen and Ver Planck (1960) includes geologic mapping of the Quartzite Mountain area that includes the mine area with an emphasis on the carbonate units and quarries/tunnels existing at that time. Bowen and Ver Planck recognized the low-angle thrust of carbonate over younger intrusive granitics at Mack's Peak, the Shay–Comet fault zone along Oro Grande Canyon, contacts and folds within the carbonate sequence south of Oro Grande Canyon, the presence of cemented/indurated older alluvium, Sidewinder Volcanics, and intrusive granitics at Sparkhule Hill, and the limestone and small amounts of dolomite of Sparkhule Hill.

Howard Brown (2014) described the geology and fault structures of the Sparkhule Mountain area in a consultant's report dated November 15, 2014, as part of an effort for planning dewatering wells. Brown summarized the occurrence of Paleozoic carbonates at Sparkhule Hills as a single block resting on younger intrusive and volcanic units. The geologic model for the presence of older carbonate rocks over younger volcanic rocks is explained by Brown as a gravity slide. This arrangement is documented elsewhere in the Mojave Region.

The 7.5-minute Victorville quadrangle geologic map (Hernandez and Brown, 2008) includes the Mack’s Peak, Superior and Oro Grande Canyon areas and is based on mapping of the carbonates by Brown. Unpublished geologic mapping of the Helendale 7.5-minute quadrangle was obtained from Hernandez (personal communication) and includes the Sparkhule Hill area.

The nomenclature of geologic units designated by Hernandez and Brown were adapted for this investigation. A Geologic Map and Site Plan is presented in Appendix A.

4.0 SITE DESCRIPTION

The Oro Grande Mine is in San Bernardino County northeast of the community of Oro Grande and the Mojave River. The mine is generally located in Quartzite Mountain—an area of high relief formed within resistant bedrock and mantled by older alluvial sediments. Younger sediments are limited at Quartzite Mountain and occur in narrow washes that dissect the bedrock upland. Quartzite Mountain is in the Mojave Desert Geomorphic Province, a landlocked region enclosed on the southwest by the San Andreas fault zone and Transverse Ranges and on the north and northeast by the Garlock fault, Tehachapi Mountains and Basin and Range (Norris and Webb, 1990). The Mojave Desert Province is dominated by broad alluviated basins that receive sediments from adjacent uplands that bury the older topography. Hills and playa lakes are a common feature of the region. Geologic units in the quarry area include limestone and dolomite, schists, quartzites, hypabyssal and eruptive volcanics and older alluvium. These units are exposed in natural and quarry outcrops within the mine and adjacent areas. A description of geologic units in the quarry area is provided in a later section of this report.

5.0 MINING AND RECLAMATION PLANS

According to the Revised Reclamation Plan (84M-009) dated March 2018 and slope configurations provided in the pit highwall sections plan dated January 9, 2019, final reclaimed quarry slopes for Sparkhule indicate planned bench faces 60 feet tall with 39-foot-wide benches, yielding an overall slope angle of approximately 45 degrees. The plans for Shay Klondike, Mack’s Peak and Original Canyon indicate planned bench faces 30 feet tall with 25-foot-wide benches, yielding an overall slope angle of approximately 41 degrees. These configurations include a face angle of approximately 71 degrees. Benched slope heights up to 360 feet, 60 feet, 870 feet, 840 feet and 720 feet are proposed for the Superior, Mack’s Peak, New

Original, Sparkhule Phase II and Sparkhule Phase I slopes, respectively. A Site Plan is included in Appendix A.

6.0 FIELD INVESTIGATION

A Certified Engineering Geologist mapped existing mine and native slopes in the reclamation area during January 2019. This included measuring the orientation of geologic contacts and structures including faults, bedding, joint and foliation orientation using a Brunton compass. These data were recorded on a paper log and locations noted on aerial photographic maps. Our focus was on continuous features that can affect kinematic stability of quarry slope faces and wall-scale faults and contacts. We included structural data from prior investigations in the kinematic data set as appropriate. A Geologic Map and Site Plan, compiled based on mapping by others, is provided in Appendix A. Geologic structural mapping areas referred to herein are numbered and indicated on the attached Geologic Map and Site Plan.

7.0 SITE GEOLOGY

Geologic units within the reclamation areas include stockpile fills (quarry waste), alluvium of several ages, intrusive rocks, volcanics and metasedimentary rocks. The units summarized below form the primary geologic materials in the quarries and adjacent areas. A Geologic Map and Site Plan compiled from published and unpublished mapping by Hernandez and Brown (2008) is included in Appendix A.

7.1 Geologic Units

Qf – Modern alluvial fan deposits mantle older materials along the axis of Oro Grande Canyon. These materials consist of unconsolidated sand and gravel derived from bedrock and older alluvial sources.

$Qof_{1,2}$ – Older alluvial fan deposits of Pleistocene age occur as dissected and isolated remnants of fans. These include sand and gravel materials and locally include pedogenic carbonate developed as soil horizons and surfaces with desert pavements.

Qoa – Old alluvial deposits occur southeast of Mack’s Peak along Oro Grande Canyon and consist of sand and gravel clasts. Gravels are predominantly granitic and exhibit pedogenic clay coatings.

QTf – Fanglomerate occurs as a widespread mantle on older bedrock units between Oro Grande Canyon and the Sparkhule area. This unit is moderately consolidated to well indurated gravel and pebbly sand forming very deeply dissected old alluvial fans. Deposits are poorly stratified, poorly sorted, and consist of angular clasts derived from nearby basement ridges to the south and east. Deposits north of Oro Grande contain abundant boulders of quartzite and metamorphosed limestone derived from metasedimentary rocks of the Quartzite Mountain area and are pervasively cemented with calcium carbonate.

Kgd, Jg – Intrusive granitic rocks occur along Jessie Saddle and as isolated tongues within older rocks south of Oro Grande Canyon. Widespread outcrops occur on the flanks of Quartzite Mountain. These rocks include quartz diorite and granite (Jg). The granite (Jg) at Jessie Saddle is described by Hernandez and others (2008) as: Leucocratic granite, porphyritic granite and muscovite-bearing granite. Very light tan (fresh surface), and very light gray (weathered), fine- to medium-grained, and contains abundant quartz. Unit typically occurs as small plutons. Porphyritic texture and lineation observed in outcrop along Oro Grande Canyon suggests hybabyssal emplacement. Unit locally intrudes Paleozoic metasedimentary units at Quartzite Mountain.

Jsla – Sidewinder Volcanics - fine-grained andesite, and andesite porphyry. Unit is greenish-brown to dark-olive-gray-green, very fine grained, and slightly metamorphosed. Unit consists of quartz and feldspar, with significant amounts of hematite staining throughout the rock. Unit is exposed as blocky, jagged outcrops north of Oro Grande Canyon. Brown (2014) indicates Sidewinder units beneath overlying older carbonate units (mine resource) in thrust contact. The sheared footwall of the Sidewinder with overlying carbonate units is exposed along the east and south sides of Sparkhule quarry and is identified in drill logs.

Paleozoic Sedimentary Rocks – A suite of metamorphosed sedimentary units occurs in the Quartzite Mountain area and includes the carbonate units that are the resource for the CalPortland quarries. South of Oro Grande Canyon these units include:

- Bird Spring Formation (Pbs) interbedded light to dark gray limestone and marble, medium-bedded medium- to dark-gray limestone, cherty limestone and silty limestone. Occurs only at and mined at Sparkhule
- Monte Cristo Limestone (Mmcb, Mmca) medium to thick bedded light gray to white calcite marble (Bullion member) and banded white to dark gray wollastonite marble (Arrowhead and Yellowpine members)
- Bonanza King (€bk, €bku, €bkl, €bku-c) marble and dolomite with siliceous silty layers
- Carrara Formation (€cu, €cl) schist, hornfels, calc-silicate and impure carbonate, and limestone. Mined at Shay-Klondike quarry and crops out along Oro Grande Canyon.

- Zabriske Quartzite (€z) white to very light gray quartzite, thick bedded to massive with occasional laminations
- Wood Canyon Formation (€Zwcu, €Zwcc, €Zwcl) quartzite, schist, carbonate and mica schist. Occurs throughout Quartzite Mountain south of Oro Grande Canyon.

7.2 Geologic Structure

The mine reclamation area includes geologic units of a variety of rock types and ages including geologically young sediments, Mesozoic intrusive rocks and Paleozoic sedimentary rocks. Structural elements within the rock units are related to age, degree of folding or faulting, and mineral content of the various geologic units. The major structures include inactive faults, brecciated and gouged thrust contacts, bedding, joints, and cleavage foliations. At the mine bench scale, the primary influence on stability of rock material is the degree of jointing coupled locally with fault or thrust gouge zones. At the mine wall scale, the larger-scale fault and thrust structures influenced locally by bedding provide the primary structure. Bench-scale features were examined in the field at selected locations and compiled into a database for kinematic evaluation. Wall-scale features were included in compilation of the geologic map from various sources and observed locally within the quarries. Major elements of the wall-scale structure include:

- Sheared footwall contact of Paleozoic rocks resting on Sidewinder volcanic units that dips between 25 and 40 degrees southward along the northern side of the quarry
- Sheared contact between Sidewinder volcanics and overlying Paleozoic rocks along the south side of the quarry
- Northeast-trending fault (N65E fault) with vertical and right-lateral components located northwest of the current quarry limit and forming a groundwater barrier
- Several northwest trending northwest plunging folds that expose Sidewinder units in the cores of antiforms

A table summarizing geologic structures mapped at the bench scale is included in Appendix C. Geologic structure was included in the cross sections for consideration of the effect on stability.

8.0 SEISMIC CONSIDERATIONS

The ground-shaking hazard at the site was evaluated from a deterministic standpoint for use as a guide to formulate an appropriate seismic coefficient for use in slope stability analysis. The deterministic calculation of peak ground acceleration (PGA) was made using attenuation relations of Boore and Atkinson (2008), Campbell and Bozorgnia (2008) and Chiou and Youngs (2008). For the San Andreas fault with a magnitude of 8.0 at a distance of 37 kilometers, the estimated PGA is 0.29g. The Helendale fault, with a magnitude of 7.4 at a distance of 9.7 kilometers, yields a PGA of 0.53g.

The simplified procedure of Bray and Travasarou (2009) for selection of critical acceleration (Kh) as one-half PGA is commonly used for slope stability calculations for habitable structures. Their method is not typically required or applicable for quarry slope design. Given the project location in an area of moderate seismic potential, we used Kh = 0.20, consistent with Bray and Travasarou (2007), to approximate one-half the value of PGA from the deterministic calculation for the closest fault.

The application of Kh = 0.2 is also consistent with a conservative application of methods described by Seed (1979). Seed (1979) considered the size of a sliding mass and earthquake magnitude in selection of Kh (horizontal seismic coefficient) for slope stability considerations. For large slopes, Seed suggested Kh = 0.15 for sites near faults capable of generating magnitude 8.5 earthquakes. The closest fault to the site, the Helendale fault, is assigned a characteristic magnitude of 7.4 (Petersen and others, 2008). Based on the method of Seed (1979) and the seismic setting of the site, we selected Kh = 0.20 as an appropriate value for evaluation of proposed reclamation slopes under seismic conditions.

9.0 GROUNDWATER

Groundwater measurements were recorded for several drill holes within the Sparkhule quarry as documented on a geologic map from Riverside Cement (former owner) dated September 5, 2014. Water elevations appear to be influenced by the presence of a northeast-trending fault (N65E Fault) described by Brown (2014). Elevations of water southeast of the fault were at 2,940 feet amsl while water northwest of the fault was at elevation 2,705 feet amsl—a difference of 235 feet. Dewatering measures to accommodate anticipated perched groundwater seepage during deepening of the quarry into Phase II include use of a sump collection area. Groundwater conditions at completion of mining (reclamation stage) may include water seepage and ponding of limited extent. Groundwater is not anticipated to significantly affect the stability of the proposed reclamation slopes. Our evaluation considered dry conditions in the slope stability calculations and one scenario for ponded water in Sparkhule to demonstrate stability with water in rock units.

10.0 SLOPE STABILITY

Slope stability calculations of proposed reclamation slopes and kinematic analysis of potential failure geometries in rock benches were performed for the quarries of the amended plan. The kinematic data include recently measured geologic structures and pertinent data from prior investigations and mapping. Global slope stability was evaluated along cross sections representing the tallest and steepest proposed slopes in each quarry with consideration of the various geologic units and structures as they potentially affect the wall-scale stability. Evaluation of bench-scale blocks above a shear contact between limestone and volcanics along the north quarry was also considered. A discussion and summary of these analyses are presented below. The slope stability data and calculations are presented in Appendices C and D.

10.1 Kinematic Analysis

Kinematic analysis involves the evaluation of rock slope stability based on the presence of structural discontinuities including bedding planes, joints, faults, shear zones, and foliations. Kinematic analysis addresses only the potential failure mode(s) and does not consider mass, force, shear strength, or cohesion along surfaces as in a limit-equilibrium analysis. Structurally controlled kinematic failure modes include planar, wedge, and topple failures. Circular failure of highly fractured rock masses is also a potential failure mode and is considered in the analysis of global stability.

Stereonet analysis (Rocscience, 2018a) for representative slope/bench aspects was performed utilizing the data compiled from mapping and measurement of geologic structures (Appendix C). The proposed maximum bench face angle (71 degrees) was evaluated for various slope facing directions (azimuth) shown on the reclamation plan. Planned reclaimed slope orientations vary between quarries and location within each quarry. Planned primary orientations in Sparkhule are southeast/northwest and southwest/northeast. Primary reclaimed orientations in New Original are east, north/south, southwest and northwest. Stereonets are presented using a north-facing aspect for the model slope; however, a continuum of orientations was evaluated using the stereonet software capabilities.

Planar analysis considers dip vectors of measured planar features. Planar sliding requires a releasing surface—a joint, tension crack or daylighted plane—to allow sliding to occur. Kinematic analysis does not consider the geometry of releasing surfaces or the presence of bonded contacts along the sliding plane; therefore, actual conditions are typically more stable than suggested by kinematic results. The potential for planar sliding or wedge failure suggested by stereonet analysis should be considered a conservative estimate of probability subject to mitigation by mining practices such as scaling and adjustment of slope face angles to the structural geometry and conditions encountered during mining. Wedge analysis generates dip vectors for the intersections of all planes; therefore, wedge analysis generates a large number of vectors to evaluate. Topple analysis identifies the potential for columns to form along steeply dipping joint systems or contacts to tilt out of the excavated face along separation surfaces. The stereonet data plots are presented in Appendix C. Tables 1.1 and 1.2 summarize the results of kinematic evaluation.

Table 1.1: Summary of Kinematic Evaluation—Superior, Mack's Peak, Original Canyon			
Azimuth	**Percentage Critical Points – 71-Degree Face**		
(degrees)	**Planar**	**Wedge**	**Topple (direct)**
0	2.5	13	7
50	23	32	7
100	3	22	4
150	17	31	3.5
220	0	12	4
260	8.5	17	16
300	2.5	12	13

Table 1.2: Summary of Kinematic Evaluation—Sparkhule			
Azimuth	**Percentage Critical Points – 71-Degree Face**		
(degrees)	**Planar**	**Wedge**	**Topple (direct)**
0	13	26	5.5
50	2.8	17	3.5
100	5.5	15	8
150	2	10	7
220	4.5	13	10
260	6	15	9.5
300	3.5	16	5

The stereonet evaluation provides results as a percentage of points in a data set with a geometrically feasible orientation to undergo a particular failure mode. In general, the percentage value relates to probability of a particular failure mode. Probabilities below 8 percent suggest low failure potential, 8 percent to 25 percent a low to moderate potential, and values above 25 percent (blue shading) a moderate or higher potential.

For the southern reclamation area that includes Mack's Peak, Superior and New Original Canyon, the kinematic evaluation suggests low to moderate potential for planar failure, moderate potential for wedge failure and low potential for topple in the planned slopes. The relatively higher potential for planar failures is in northeast- and southeast-facing slopes. The relatively higher potential for wedge failure is in northeast- and southeast-facing slopes. The relatively higher potential for topple failure is in northwest-facing slopes.

For Sparkhule the kinematic evaluation suggests low to moderate potential for planar failure, moderate to high potential for wedge failure, and low potential for topple. The relatively higher potential for wedge failure is for northwest-, north- and northeast-facing slopes.

Based on mining practices that minimize the occurrence of hanging blocks by scaling and removal of potentially unstable localized features, the proposed final slope configuration is expected to produce a suitably configured slope geometry that mitigates rock fall for slopes in the reclaimed mine areas.

Sensitivity analysis plots are included in Appendix C for planar, wedge and topple geometries versus slope aspect (facing direction). The slope benching and configuration presented in the amended reclamation plan are considered feasible with regard to the performance of the proposed rock faces.

10.2 Global Stability Calculations

The global stability of proposed reclamation slopes, as depicted on the amended reclamation plan, was analyzed using Spencer's method under both static and seismic conditions for rotational and composite failure surfaces using the SLIDE computer program, version 8.021 (Rocscience., 2018b). Selection of the slope configurations for the analysis, which includes the tallest anticipated slope, is a most-conservative approach. The whole rock strength of the geologic units was determined in part by reference to our database of unconfined compressive strength (UCS) tests on block samples from similar geologic units and a database of Generalized Hoek-Brown rock strength parameters included in the SLIDE software application.

Slope stability calculations were performed on representative slopes modeled as summarized in the following table:

Table 2: Summary of Slope Stability Models			
Model	**Height (feet)**	**Geologic Unit (s)**	**Angle**
New Original Canyon			
Section F – Limestone Wall	600	LS	41 (overall)
Section F – Granitics Wall	870	Jg	41 (overall)
Section F – QTf Portion	30	QTf	51 (face)
Section G – Granitics Wall	870	Jg	41 (overall)
Section G – QTf Portion	118	QTf	51 (face)
Sparkhule			
Section H – LS + Jg Portion	420	LS, Jg	45 (overall)
Section H – QTf+LS+Jg (flattened QTf)	840	QTF, LS, Jg	QTf = 48 (face) LS+Jg = 45 (overall)
Section H – with Water Table	840	QTf, LS, Jg,	QTf = 48 (face) LS+Jg = 45 (overall)
Section I – QTf + LS Wall	840	QTf, LS	QTf = 48 (face) LS = 70 (face)
Section I – LS Blocks on JS	--	LS/Js	30 (shear plane)
QTf Back Calculation	61	QTf	70 (face)
Stockpile Fill	430	Fill	27 (overall)

Strength parameters for the bedrock units were modeled with the Generalized Hoek-Brown criteria (Hoek and Karzulovic, 2000 and Hoek, Carranza-Torres & Corkum, 2002), using the results of prior UCS tests on similar rock materials and the SLIDE program's integrated calculator application. The strength of stockpile fills was determined using large-scale shear tests. The strength parameter values are presented in the following tables.

Table 3.1: Limestone (LS) - Strength Parameters		
	Value	**Source**
Unit Weight (pcf*)	170	Prior data
Intact UCS[1] (psf**)	1.87×10^6	Prior UCS data
Geological Strength Index	50	Prior data
Intact Rock Constant (mi***)	10	Prior data
Disturbance Factor	1	Production blasting

* pcf = pounds per cubic foot
** psf = pounds per square foot
*** mi = unitless constant

Table 3.2: Granitics (Jg) – Strength Parameters		
	Value	**Source**
Unit Weight (pcf*)	168	Prior data
Intact UCS[1] (psf**)	2.32×10^6	Prior UCS data
Geological Strength Index	50	Prior data
Intact Rock Constant (mi***)	27	Prior data
Disturbance Factor	1	Production blasting

* pcf = pounds per cubic foot
** psf = pounds per square foot
*** mi = unitless constant

Table 3.3: Sidewinder Volcanics (Js) – Strength Parameters		
	Value	**Source**
Unit Weight (pcf*)	164	Prior data
Intact UCS[1] (psf**)	1.50×10^6	Prior UCS data
Geological Strength Index	37	Prior data
Intact Rock Constant (mi***)	25	Prior data
Disturbance Factor	1	Production blasting

* pcf = pounds per cubic foot
** psf = pounds per square foot
*** mi = unitless constant

Table 3.4: Fanglomerate (QTf) - Strength Parameters		
	Value	**Source**
Unit Weight (pcf*)	125	Estimated
Cohesion (psf)	400	Back calculation
Friction Angle	42	

*   pcf = pounds per cubic foot
** psf = pounds per square foot

Table 3.5: Stockpile Fill - Strength Parameters		
	Value	**Source**
Unit Weight (pcf*)	125	Estimated
Cohesion (psf)	81	Measured
Friction Angle	41	

*   pcf = pounds per cubic foot
** psf = pounds per square foot

The analysis of fanglomerate slopes included determination of the steepest 30-foot-tall model slope (face angle) that would accommodate stability requirements for static and seismic conditions. Back calculation of strengths was utilized for fanglomerate material based on a 70-degree face standing 60 feet tall as observed in the field. This results in flatter slopes in fanglomerate (QTf) than rock materials. A water table was modeled in Sparkhule (Section H) to demonstrate stability of rock slopes in the proposed pit if water collects after reclamation (note that this model is not intended as an indication that water is anticipated in Sparkhule after reclamation). Limestone (LS) blocks resting in shear zone contact with Sidewinder volcanics (Js) was modeled in a portion of Section I to demonstrate the potential for bench-scale features with FS near unity where these features remain after mining. This model is for illustration only and is not based on measured conditions.

The results of global slope stability analyses are summarized below. Details of stability calculations including material type boundaries, strength parameters, and the minimum factor of safety and critical slip surface are presented in Appendix D.

Table 4: Summary of Global Stability Results				
Model	**Materials**	**Slope Configuration**	**Static Factor of Safety**	**Seismic Factor of Safety (k=0.2)**
Section F Limestone Wall	LS	600 feet @ 41 deg.	2.00	1.48
Section F Granitics Wall	Jg	870 feet @ 41 deg.	2.60	1.91
Section F QTf	QTf	47 feet @ 51 deg.	1.90	1.46
Section G Granitics	Jg	870 feet @ 41 deg.	2.47	1.81
Section G QTf portion	QTf	118 @ 40 deg. 51 deg. faces	1.51	1.09
Section H Rock Portion	LS, Js	420 feet @ 45 deg.	2.09	1.59
Section H Whole Slope	QTf, LS, Js	840 feet @ 33 deg. QTf (overall) 45 deg. Rock (overall)	1.59	1.08
Section H Water table	QTf, LS, Js	840 feet @ 33 deg. QTf (overall) 45 deg. Rock (overall)	1.59	1.08
Section I QTf on Limestone	QTf, LS	840 feet QTf 48 deg. Face LS 44 deg. Overall	1.53 in QTf 1.89 in LS	1.15 in QTf 1.38 in LS
Stockpile	Fill	430 feet @ 27 deg.	1.81	1.18

Sufficient static factors of safety (FS) in excess of 1.5 and seismic factors of safety at or greater than 1.1—in conformance with Office of Mine Reclamation (OMR) criteria—were indicated for the modeled rock slope, fanglomerate and stockpile configurations for the modeled slope heights and gradients.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our geologic field observations and results of our slope stability analysis, it is the opinion of this firm that the proposed rock and stockpile reclamation slopes are feasible with respect to slope stability from a geotechnical standpoint. Slopes formed in the fanglomerate (QTf) unit are stable by calculation at angles near 50 degrees utilizing 30-foot-tall faces. Consideration of QTf in reclamation may include modification of geometry to achieve suitable faces and overall slope angles in this material.

The following slope heights/angles versus materials are considered feasible for reclamation:

- Rock materials including limestone and granitics—45 degrees up to 870 feet in height
- Sidewinder Volcanics (Js)—45 degrees up to 670 feet in height
- Overburden Stockpile (OB) fill—27 degrees up to 430 feet in height
- Fanglomerate (QTf)—33 degrees (overall) to 420 feet in height, 50-degree faces to 30 feet in height

Based on the elevation of the proposed pit bottom, groundwater may occur within the maximum mined depth. A calculation of rock slope stability indicates that global stability of slopes formed in rock materials is not reduced by the presence of a water table at Elevation 2705 (amsl) after reclamation.

Moderate to severe seismic shaking of the site can be expected to occur during the lifetime of the proposed mining and reclamation. This potential has been considered in our analyses and evaluation of slope stability.

The proposed rock slope configurations are considered suitably stable under static and seismic conditions as reclaimed slopes. Inclusion of horizontal safety benches in final slope design is an effective protection from rockfall, will reduce tensional forces in surface rock, and will reduce surface erosion rates (Highland and Brabowsky, 2008). Slopes may be protected with berms as necessary to prevent slope erosion in areas where overland flow is directed toward slopes.

The configuration of wall height, wall angle and bench width is controlled primarily by the type of mining equipment used and the geologic structure and bench face angles that can be achieved (Ryan and Pryor, 2000). Typical wall heights in hard rock mines range from 40 to 50 feet, which is near the expected range for the proposed quarry reclamation.

The rock mass within the Sparkhule quarry is generally hard, competent and capable of forming stable slopes at the proposed slope angles for reclamation. The rock structure includes joint systems that have been characterized by mapping and analysis to yield suitably stable rock slopes. Localized structures at the bench scale may form zones that require scaling and/or excavation to flatten or steepen face angles to achieve suitable reclamation conditions. At such time and locations as reclamation slopes are excavated, a qualified professional should examine the slope conditions to determine conformance with the reclamation plan.

The area of the proposed New Original Canyon quarry is mantled with fanglomerate in the northwestern portion. Characterization of geologic structure within this plan area relied on surface mapping of bedrock units as exposed south of Oro Grand Canyon Road and in the Cut and Mack's Peak areas. Use of drill hole data for the New Original Canyon, when available, may allow a better understanding of anticipated reclamation conditions primarily with respect to the thickness of the fanglomerate unit.

Slow raveling processes during and after quarry operation, with time, may result in deposition of limited talus on benches. Talus left on the benches can facilitate revegetation and lend a more natural appearance to the reclaimed slopes. It is anticipated that rock fragments will be angular and relatively resistant to rolling. Therefore, rockfall hazard is not anticipated for properly excavated and scaled rock slopes.

Based on anticipated reclamation slope conditions, use of steel netting or other structural installations to mitigate toppling or rockfall is not considered necessary; however, these measures, as well as a berm at the toe of the final quarry slopes, may be considered if warranted by future conditions. As is typical for any surface mining location, we recommend periodic observation of mine benches for indications of potential instability above working areas during mine operations.

Visual inspection of rock excavations and reclamation slopes/benches should be performed to address the potential for unknown or newly exposed discontinuities/geologic conditions. If raveling or instability is evident due to features in the geologic structure, the bench width may be increased to provide a suitable buffer to daylighted or unstable features and a sufficient area to mitigate rockfall.

The kinematic condition associated with the interaction of the N65E fault and bedding planes, if exposed in Sparkhule reclamation slopes, should be examined. The interaction of the shear contact above the Sidewinder Volcanics units and bedding along the southern side of Sparkhule may also be of interest.

Production blasting is suitable for developing mine slopes. However, when reclaimed slope faces are reached, blasting should be planned and controlled so that final catch benches are constructed in accordance with the approved reclamation plan. Degradation or clogging of catch benches may allow rockfall to reach lower mine levels.

Provision of terraces and/or berms to convey surface drainage away from slope faces in overburden stockpile slopes should be considered for reclamation stockpile slopes.

This report is intended to address the proposed reclamation and is not applicable to working mine (interim) slopes, including existing slopes and conditions, which may be steeper and/or of different configuration than the reclamation plan.

12.0 GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the geotechnical conditions in the area, the data obtained from our site reconnaissance and available exploration data and from our understanding of the project. Variations will occur between exploration point locations, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after mining. If variations appear, we can provide further evaluation and supplemental recommendations, and we should be immediately notified to provide this evaluation.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes only. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

We appreciate this opportunity to be of service and trust this report provides the information desired at this time. Should questions arise, please do not hesitate to contact this firm at your convenience.

Sincerely
Terracon Consultants, Inc.

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Reviewed by: David A. Baska, Ph.D., G.E.

JMc/JJM:lb

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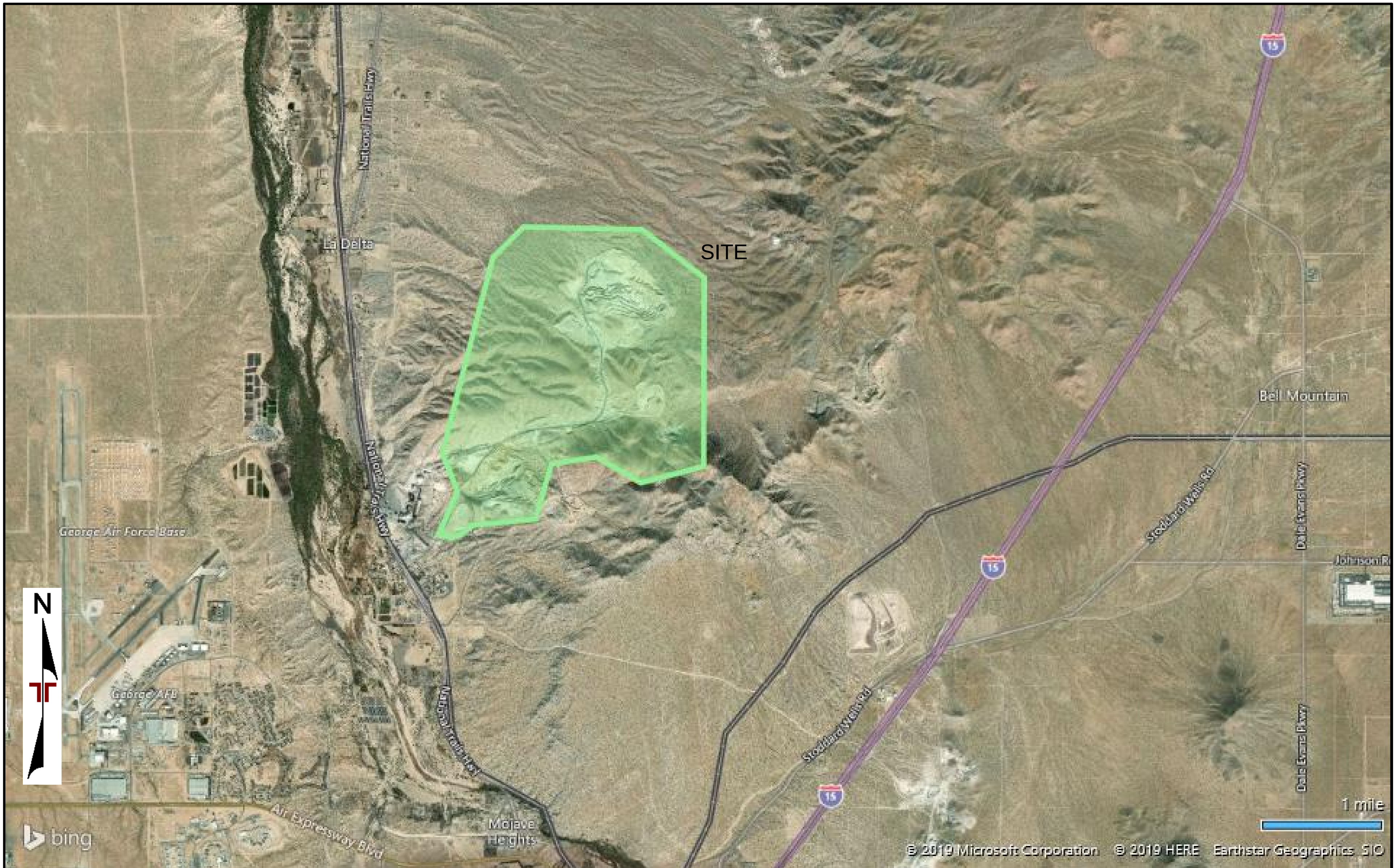
AERIAL PHOTOGRAPHS EXAMINED

Google Earth web-based software application, aerial imagery dated May 28, 1994; June 4, 2003; December 31, 2004; December 31, 2005; May 24, 2009; March 21, 2013; January 1, 2015; September 4, 2016; June 13, 2016; December 28, 2017.

APPENDIX A

MAPS



AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: JMc	Project No. CB185153
Drawn by: JMc	Scale: AS SHOWN
Checked by:	File Name:
Approved by:	Date: JAN 2019

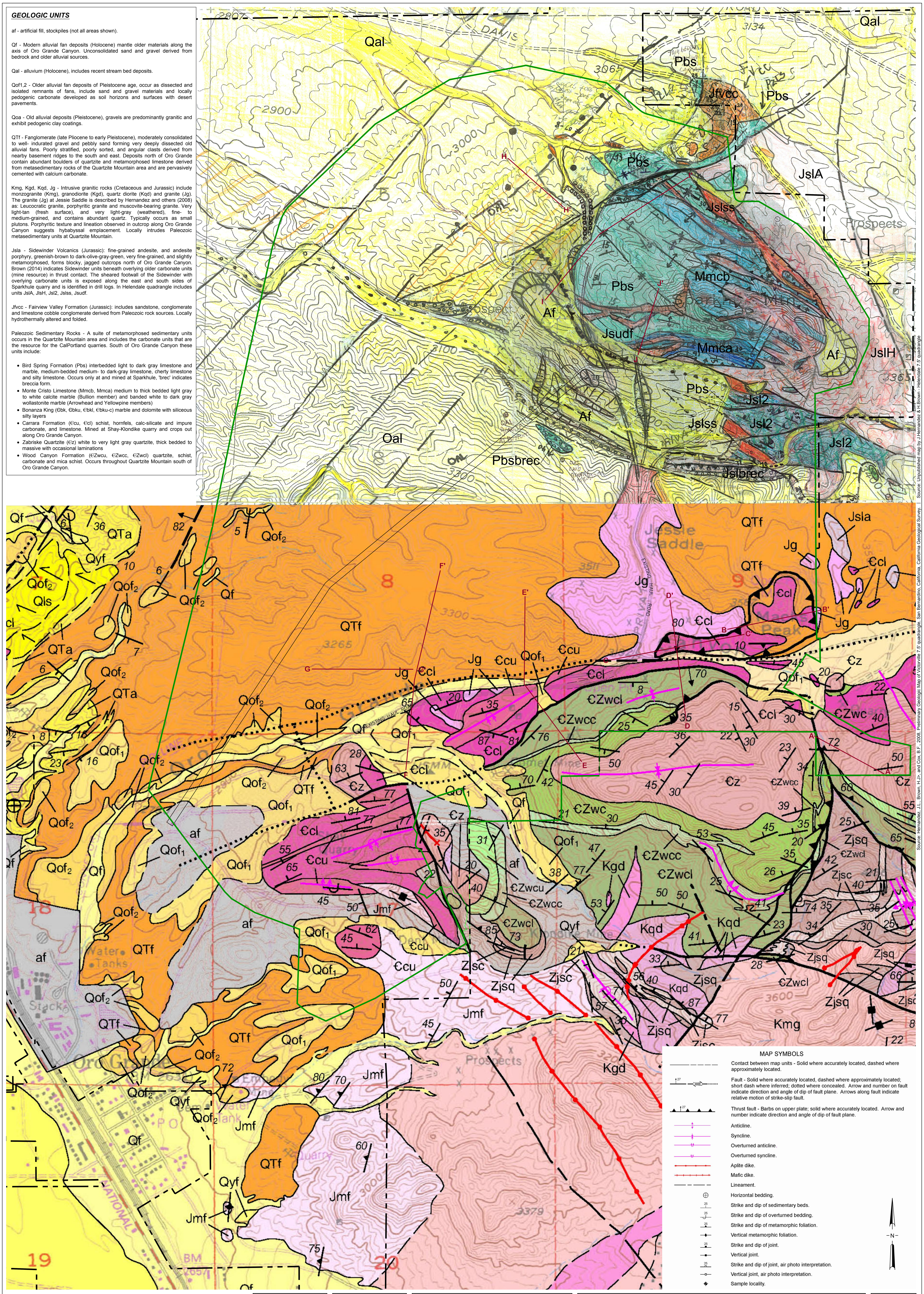
Terracon

1355 E Cooley Dr, Ste C
Colton, CA 92324-3954

SITE LOCATION

CalPortland Oro Grande Amended Reclamation Plan
19409 National Trails Highway
Oro Grande, CA

Exhibit
A-1



GEOLOGIC UNITS

af - artificial fill, stockpiles (not all areas shown).

Qf - Modern alluvial fan deposits (Holocene) mantle older materials along the axis of Oro Grande Canyon. Unconsolidated sand and gravel derived from bedrock and older alluvial sources.

Qal - alluvium (Holocene), includes recent stream bed deposits.

Qof1,2 - Older alluvial fan deposits of Pleistocene age, occur as dissected and isolated remnants of fans, include sand and gravel materials and locally pedogenic carbonate developed as soil horizons and surfaces with desert pavements.

Qoa - Old alluvial deposits (Pleistocene), gravels are predominantly granitic and exhibit pedogenic clay coatings.

QTf - Fanglomerate (late Pliocene to early Pleistocene), moderately consolidated to well- indurated gravel and pebbly sand forming very deeply dissected old alluvial fans. Poorly stratified, poorly sorted, and angular clasts derived from nearby basement ridges to the south and east. Deposits north of Oro Grande contain abundant boulders of quartzite and metamorphosed limestone derived from metasedimentary rocks of the Quartzite Mountain area and are pervasively cemented with calcium carbonate.

Kmg, Kgd, Kqd, Jg - Intrusive granitic rocks (Cretaceous and Jurassic) include monzogranite (Kmg), granodiorite (Kgd), quartz diorite (Kqd) and granite (Jg). The granite (Jg) at Jessie Saddle is described by Hernandez and others (2008) as: Leucocratic granite, porphyritic granite and muscovite-bearing granite. Very light-tan (fresh surface), and very light-gray (weathered), fine- to medium-grained, and contains abundant quartz. Typically occurs as small plutons. Porphyritic texture and lineation observed in outcrop along Oro Grande Canyon suggests hybabyssal emplacement. Locally intrudes Paleozoic metasedimentary units at Quartzite Mountain.

Jsla - Sidewinder Volcanics (Jurassic): fine-grained andesite, and andesite porphyry, greenish-brown to dark-olive-gray-green, very fine-grained, and slightly metamorphosed, forms blocky, jagged outcrops north of Oro Grande Canyon. Brown (2014) indicates Sidewinder units beneath overlying older carbonate units (mine resource) in thrust contact. The sheared footwall of the Sidewinder with overlying carbonate units is exposed along the east and south sides of Sparkhule quarry and is identified in drill logs. In Helendale quadrangle includes units JslA, JlsH, Jsl2, Jslss, Jsudf.

Jfvcc - Fairview Valley Formation (Jurassic): includes sandstone, conglomerate and limestone cobble conglomerate derived from Paleozoic rock sources. Locally hydrothermally altered and folded.

Paleozoic Sedimentary Rocks - A suite of metamorphosed sedimentary units occurs in the Quartzite Mountain area and includes the carbonate units that are the resource for the CalPortland quarries. South of Oro Grande Canyon these units include:

- Bird Spring Formation (Pbs) interbedded light to dark gray limestone and marble, medium-bedded medium- to dark-gray limestone, cherty limestone and silty limestone. Occurs only at and mined at Sparkhule, 'brec' indicates breccia form.
- Monte Cristo Limestone (Mmcb, Mmca) medium to thick bedded light gray to white calcite marble (Bullion member) and banded white to dark gray wollastonite marble (Arrowhead and Yellowpine members)
- Bonanza King (Ꞓbk, Ꞓbku, Ꞓbkl, Ꞓbku-c) marble and dolomite with siliceous silty layers
- Carrara Formation (Ꞓcu, Ꞓcl) schist, hornfels, calc-silicate and impure carbonate, and limestone. Mined at Shay-Klondike quarry and crops out along Oro Grande Canyon.
- Zabriske Quartzite (Ꞓz) white to very light gray quartzite, thick bedded to massive with occasional laminations
- Wood Canyon Formation (ꞒZwcu, ꞒZwcc, ꞒZwcl) quartzite, schist, carbonate and mica schist. Occurs throughout Quartzite Mountain south of Oro Grande Canyon.

MAP SYMBOLS

Contact between map units - Solid where accurately located, dashed where approximately located.

Fault - Solid where accurately located, dashed where approximately located; short dash where inferred; dotted where concealed. Arrow and number on fault indicate direction and angle of dip of fault plane. Arrows along fault indicate relative motion of strike-slip fault.

Thrust fault - Barbs on upper plate; solid where accurately located. Arrow and number indicate direction and angle of dip of fault plane.

Anticline.

Syncline.

Overturned anticline.

Overturned syncline.

Aplite dike.

Mafic dike.

Lineament.

Horizontal bedding.

Strike and dip of sedimentary beds.

Strike and dip of overturned bedding.

Strike and dip of metamorphic foliation.

Vertical metamorphic foliation.

Strike and dip of joint.

Vertical joint.

Strike and dip of joint, air photo interpretation.

Vertical joint, air photo interpretation.

Sample locality.

N

SCALE

0 600 1200

(1 inch = 600 feet)

LEGEND:

Property Boundary

Amended Reclamation Plan Area 1937.1 Acres (2018)

A A' Location of geologic section

Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SitePlan-GeoMap
Approved By: JM	Date: JANUARY 2019

Terracon

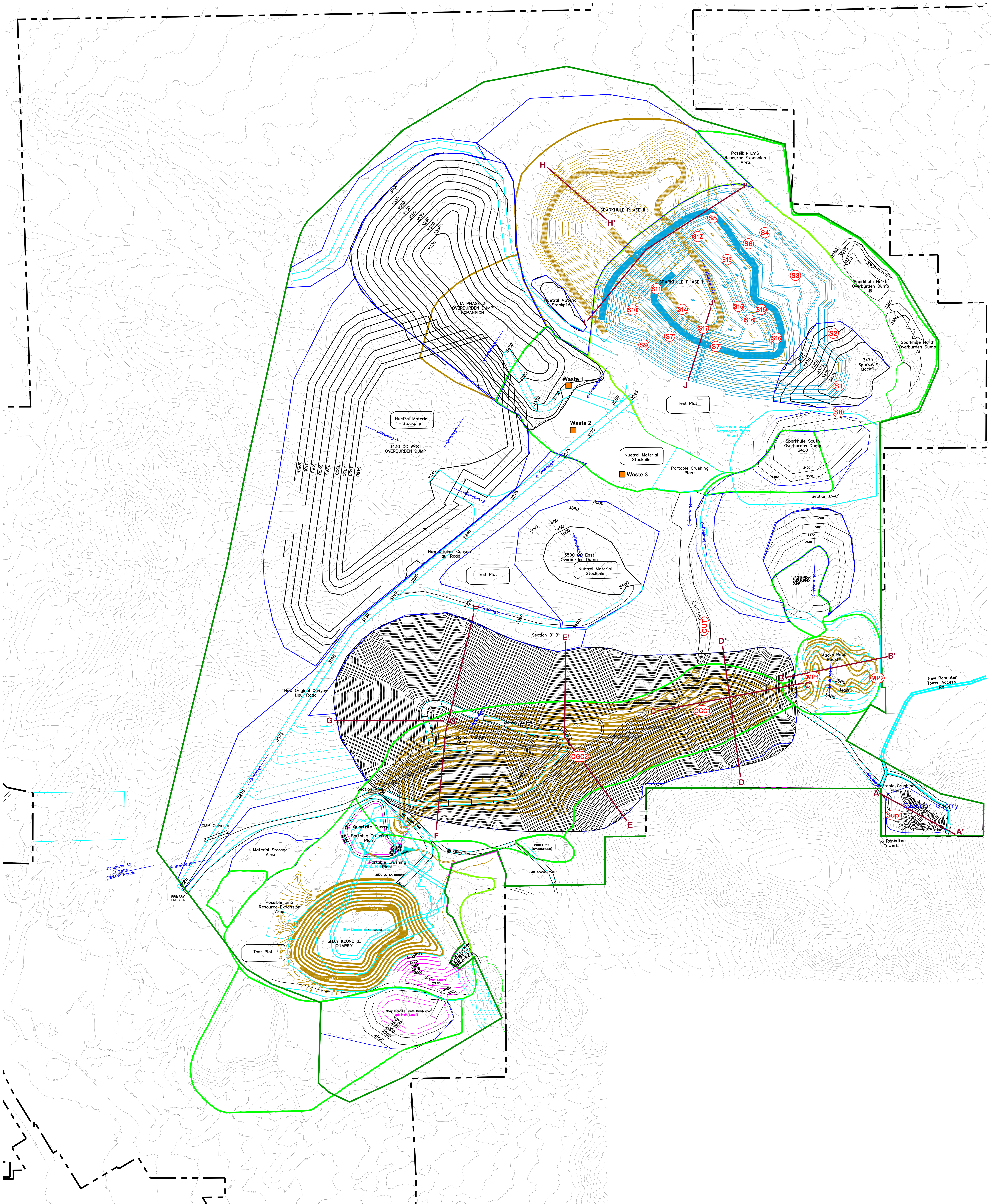
1355 E. Cooley Drive
Colton, CA 92324

SITE PLAN AND GEOLOGIC MAP

ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNADINO COUNTY, CALIFORNIA

Enclosure

A-2



LEGEND:

- Property Boundary
- Amended Reclamation Plan Area 1937.1 Acres (2018)
- A — A' Location of geologic section
- Waste 2 Stockpile sample location

Location of Structural Mapping:

- Sup1 Superior Quarry
- MP1 Mack's Peak
- OGC1 Original Canyon
- S1 Sparkhule Quarry
- CUT ?

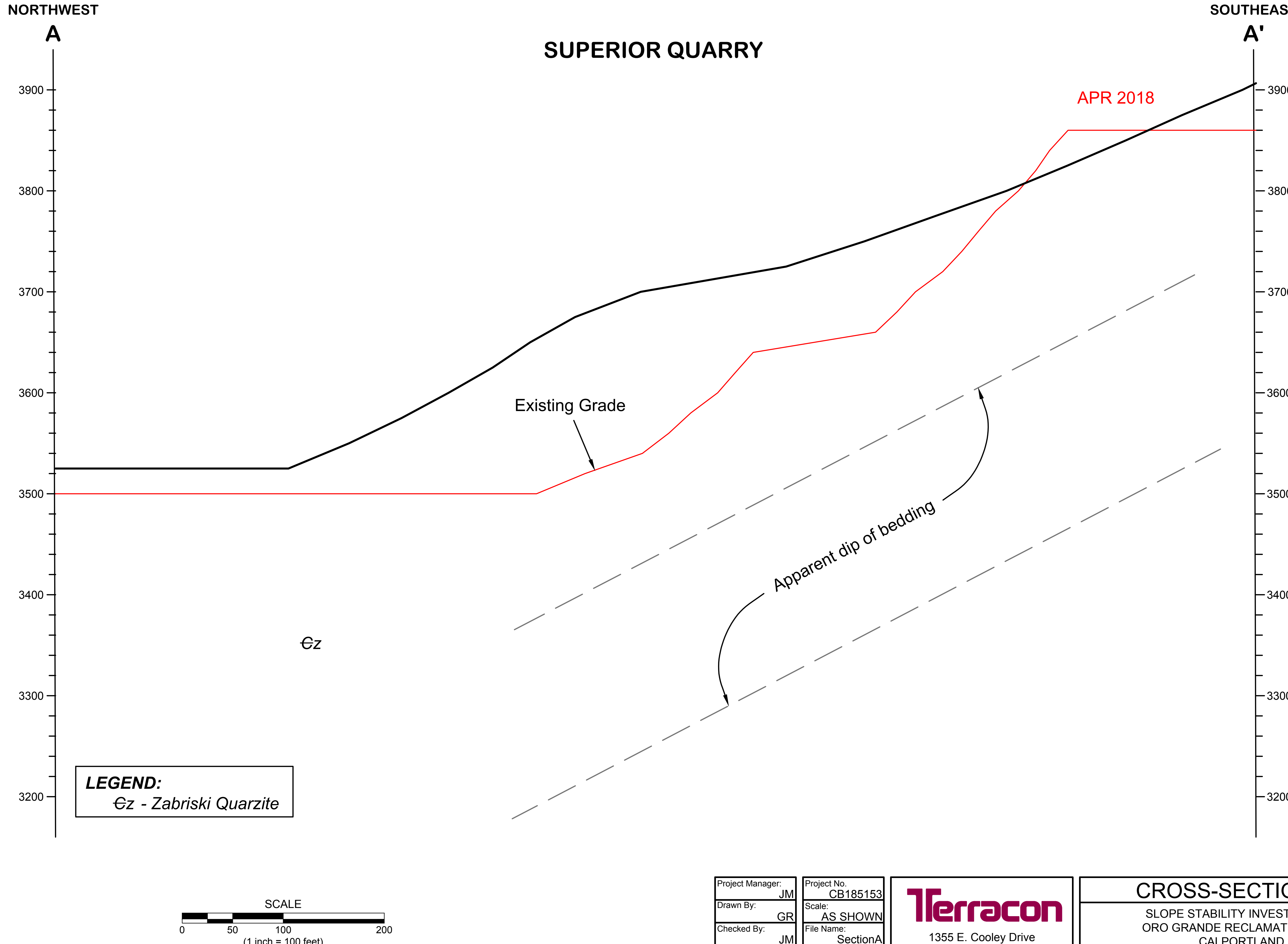
Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SitePlan
Approved By: JM	Date: FEBRUARY 2019

Terracon
1355 E. Cooley Drive
Colton, CA 92324

SITE PLAN

SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNADINO COUNTY, CALIFORNIA

Enclosure
A-3



Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SectionA
Approved By: JM	Date: February 2019

Terracon
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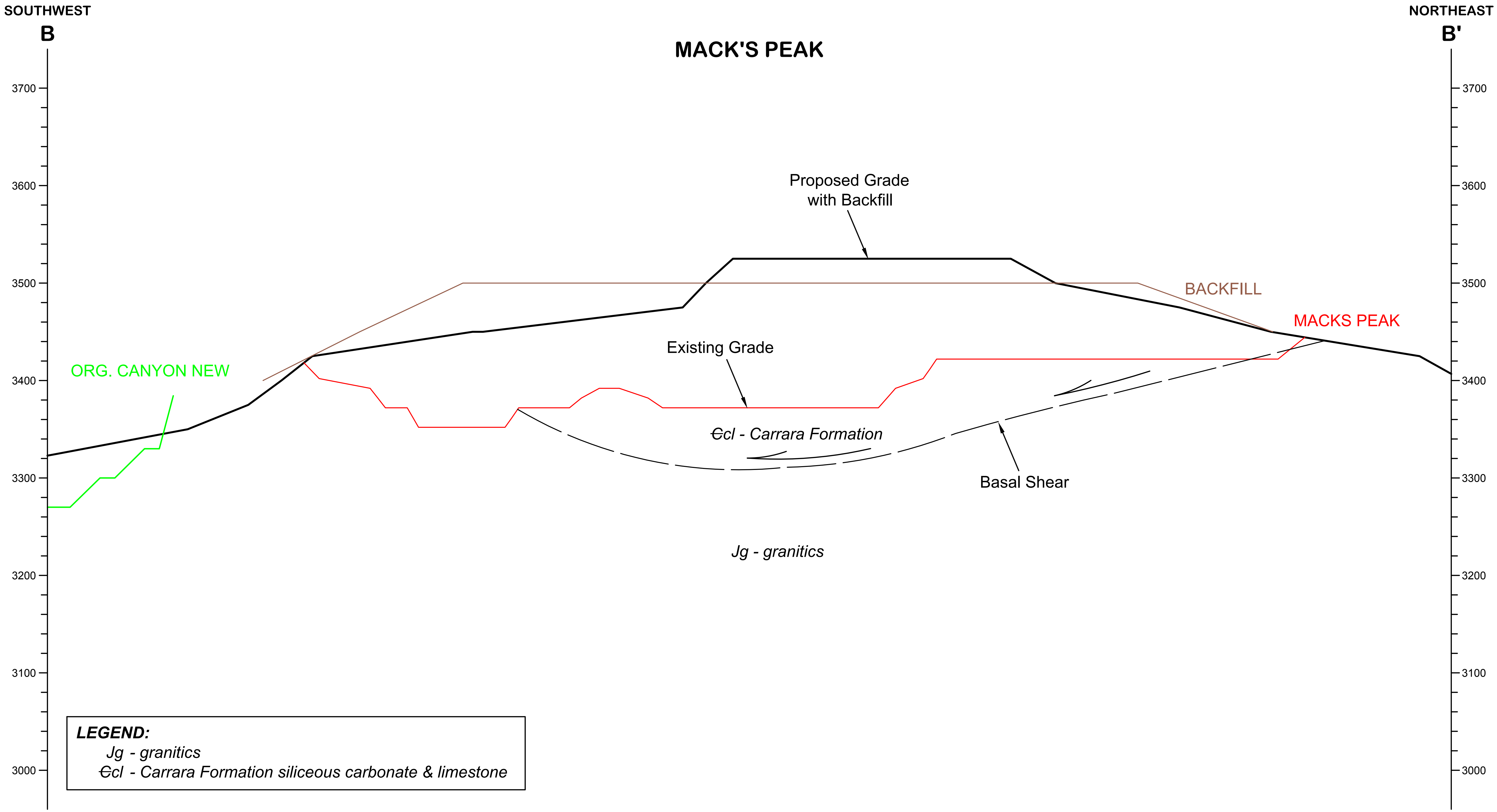
Colton, CA 92324

CROSS-SECTION A-A'

SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

Exhibit
A-4.1

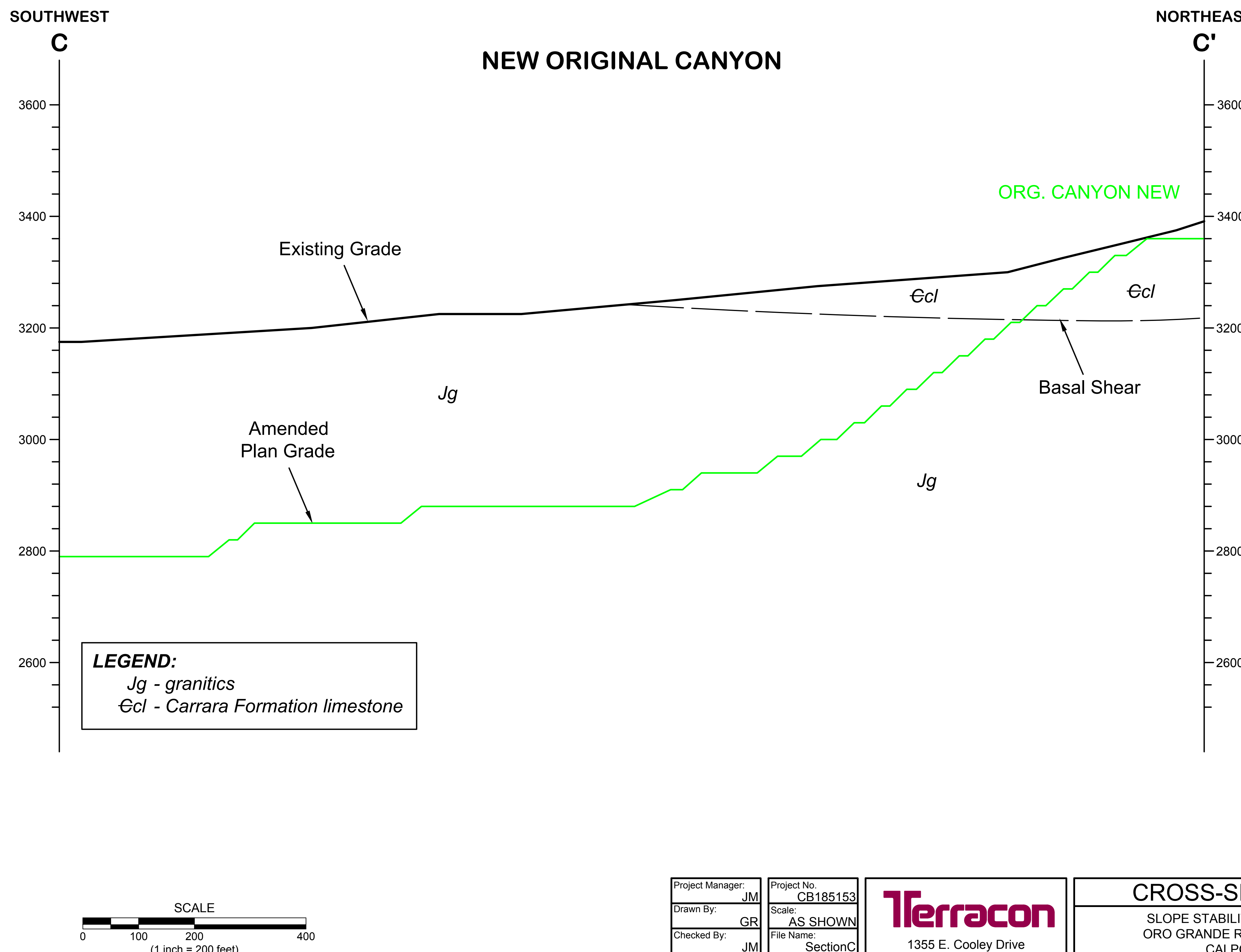


SCALE

0 50 100 200

(1 inch = 100 feet)

Project Manager: JM	Project No. CB185153	Terracon 1355 E. Cooley Drive Colton, CA 92324	CROSS-SECTION B-B'	Exhibit
Drawn By: GR	Scale: AS SHOWN		SLOPE STABILITY INVESTIGATION ORO GRANDE RECLAMATION PLAN CALPORTLAND ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA	A-4.2
Checked By: JM	File Name: SectionB			
Approved By: JM	Date: February 2019			



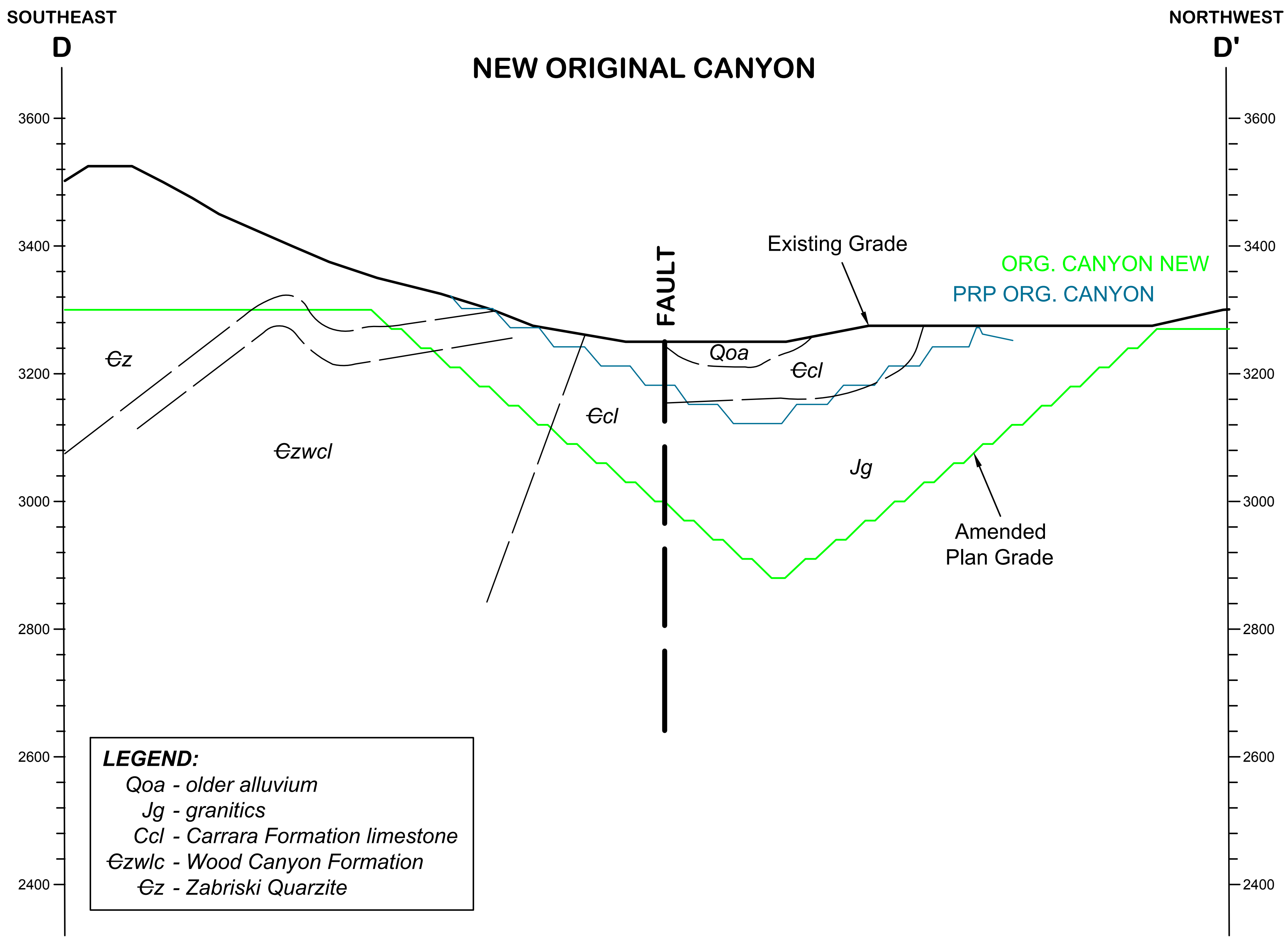
Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SectionC
Approved By: JM	Date: February 2019

Terracon
1355 E. Cooley Drive
Colton, CA 92324

CROSS-SECTION C-C'

SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

Exhibit
A-4.3



SCALE

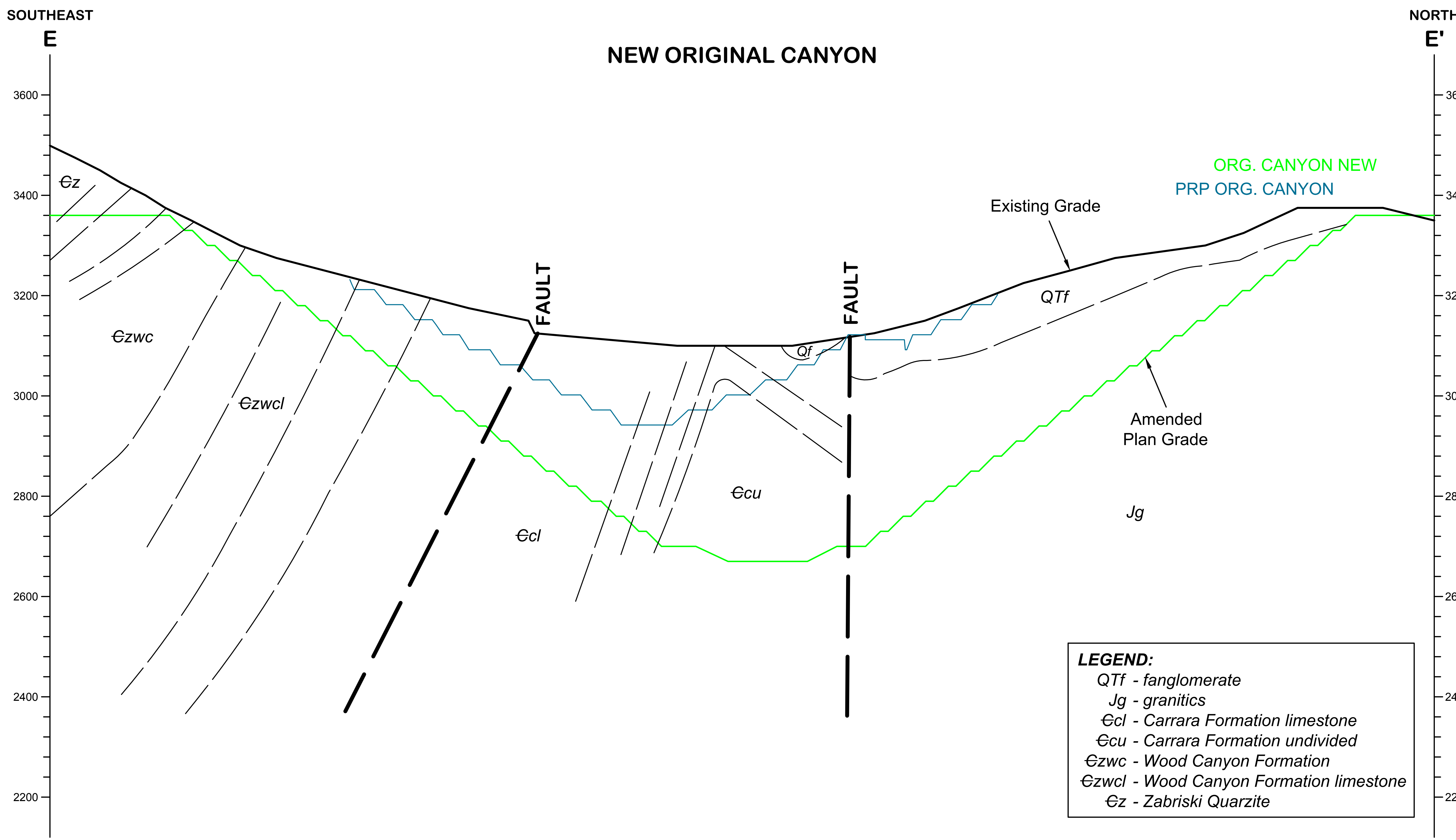
0 100 200 400

(1 inch = 200 feet)

Project Manager: JM	Project No. CB185153	Terracon	CROSS-SECTION D-D'
Drawn By: GR	Scale: AS SHOWN	1355 E. Cooley Drive	SLOPE STABILITY INVESTIGATION
Checked By: JM	File Name: SectionD	Colton, CA 92324	ORO GRANDE RECLAMATION PLAN CALPORTLAND
Approved By: JM	Date: February 2019		ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

Exhibit

A-4.4



LEGEND:

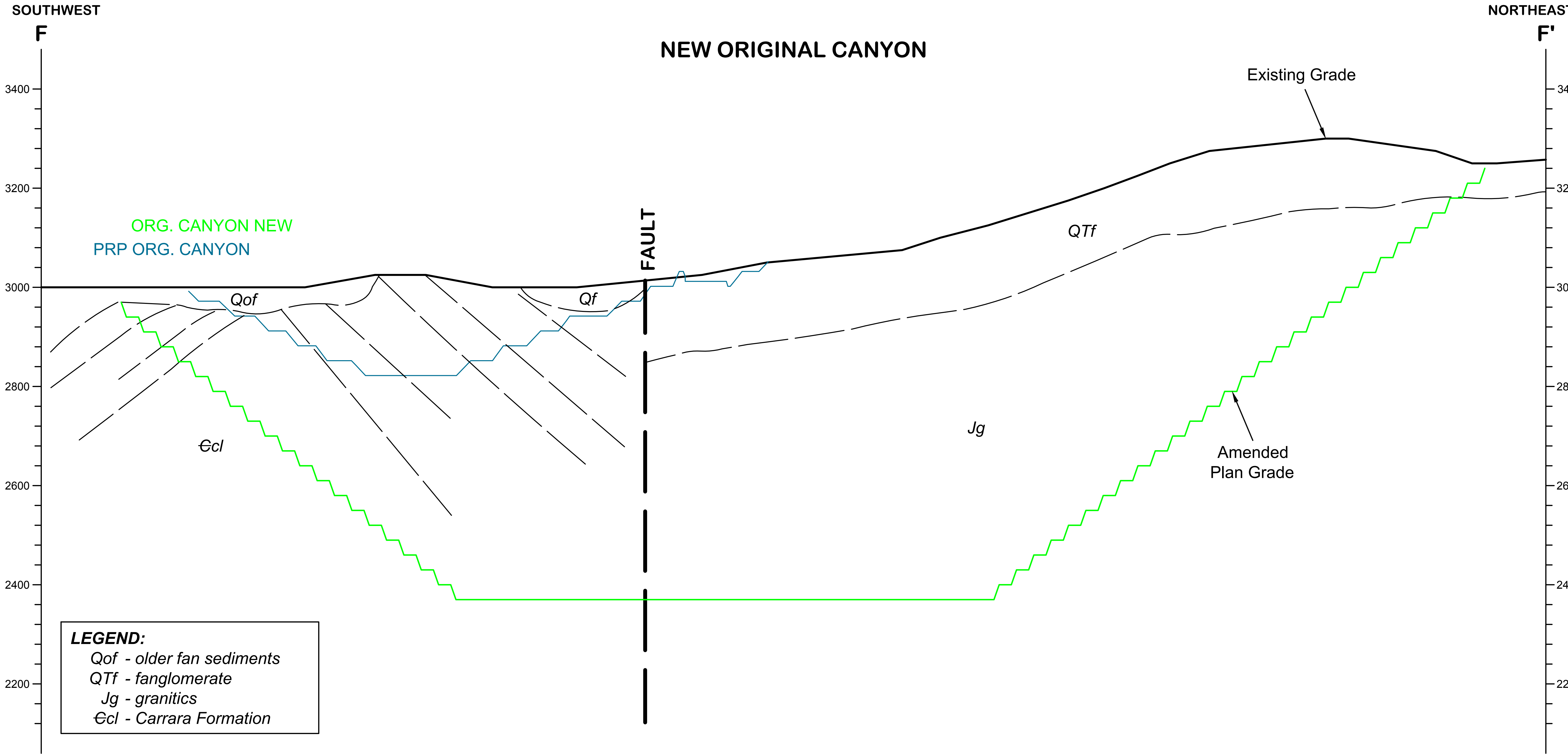
- QTf - fanglomerate
- Jg - granitics
- Ꞓcl - Carrara Formation limestone
- Ꞓcu - Carrara Formation undivided
- Ꞓzwc - Wood Canyon Formation
- Ꞓzwcl - Wood Canyon Formation limestone
- Ꞓz - Zabriski Quartzite

SCALE

0 100 200 400

(1 inch = 200 feet)

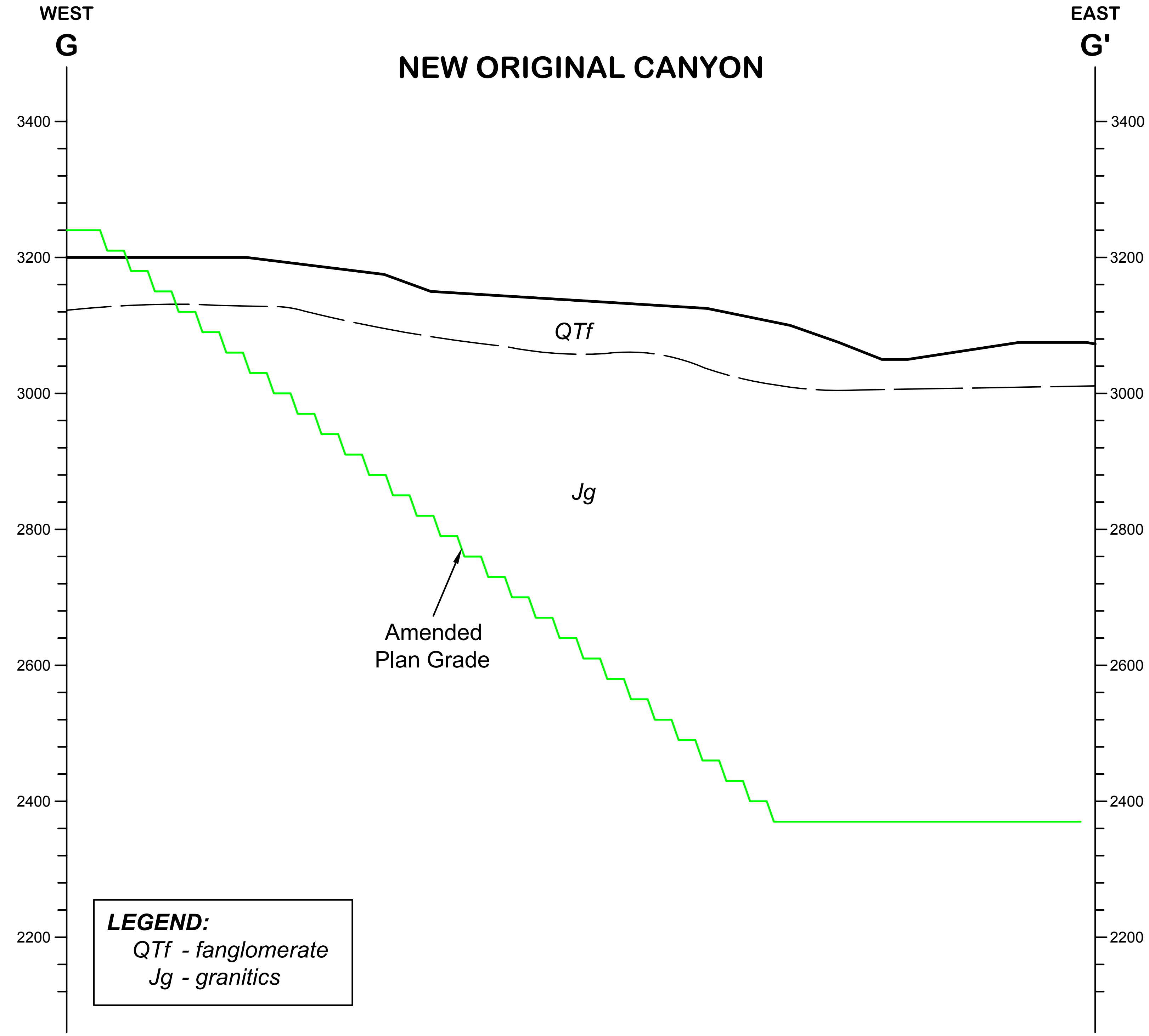
Project Manager: JM	Project No. CB185153	Terracon	CROSS-SECTION E-E'	Exhibit
Drawn By: GR	Scale: AS SHOWN	1355 E. Cooley Drive	SLOPE STABILITY INVESTIGATION	A-4.5
Checked By: JM	File Name: SectionE	Colton, CA 92324	ORO GRANDE RECLAMATION PLAN	
Approved By: JM	Date: February 2019		CALPORTLAND ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA	



SCALE
0 100 200 400
(1 inch = 200 feet)

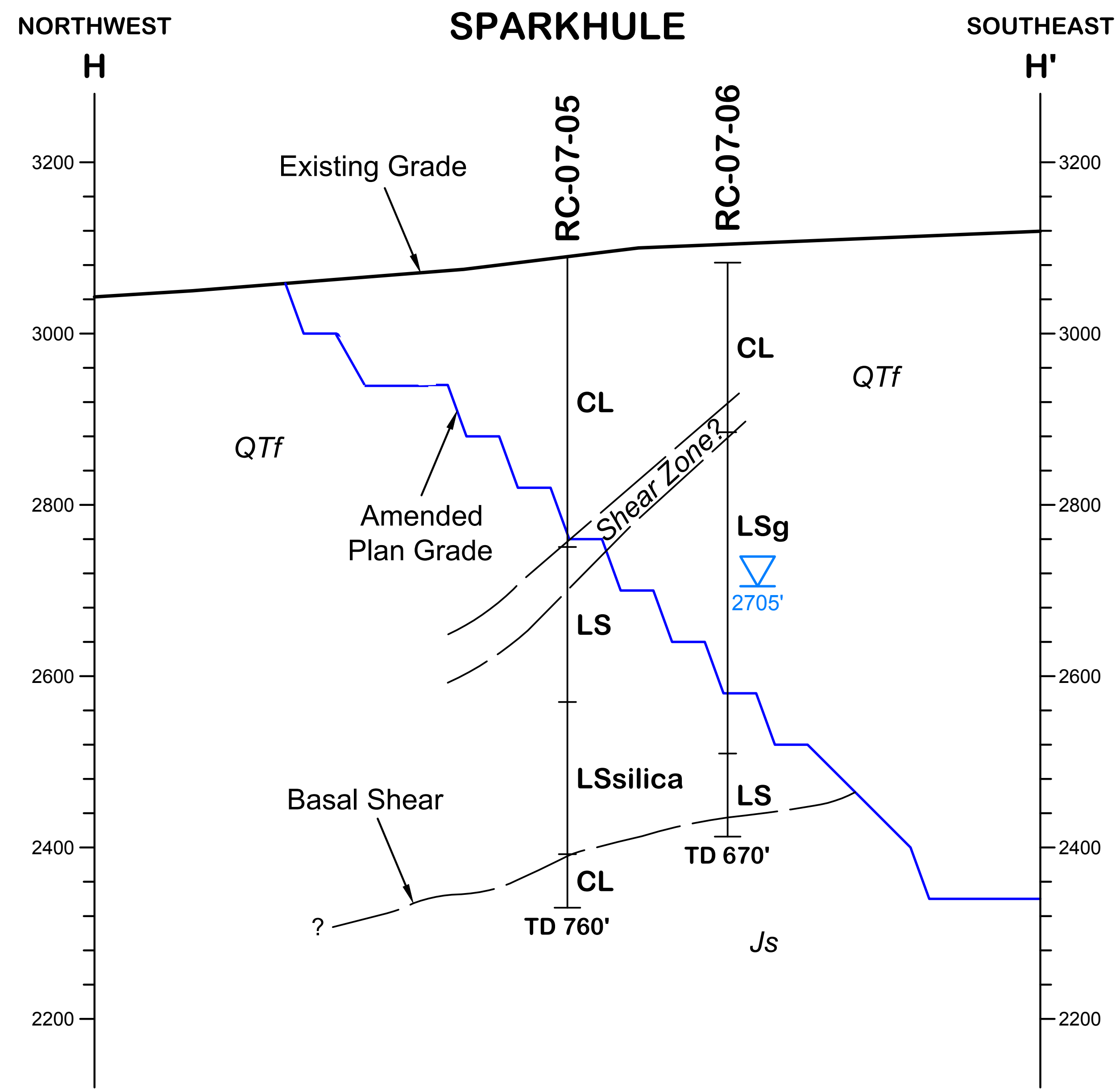
Project Manager: JM	Project No. CB185153	Terracon	CROSS-SECTION F-F'
Drawn By: GR	Scale: AS SHOWN	1355 E. Cooley Drive Colton, CA 92324	SLOPE STABILITY INVESTIGATION ORO GRANDE RECLAMATION PLAN CALPORTLAND ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA
Checked By: JM	File Name: SectionF		
Approved By: JM	Date: February 2019		

Exhibit
A-4.6



SCALE
0 100 200 400
(1 inch = 200 feet)

Project Manager: JM	Project No. CB185153	Terracon	CROSS-SECTION G-G'	Exhibit
Drawn By: GR	Scale: AS SHOWN	1355 E. Cooley Drive Colton, CA 92324	SLOPE STABILITY INVESTIGATION ORO GRANDE RECLAMATION PLAN CALPORTLAND ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA	A-4.7
Checked By: JM	File Name: SectionG			
Approved By: JM	Date: February 2019			



LEGEND:

CL - *clay*
LS - *limestone*
LSg - *gray limestone*
QTf - *fanglomerate*
Js - *Sidewinder volcanics*
▽ - *groundwater (perched?)*

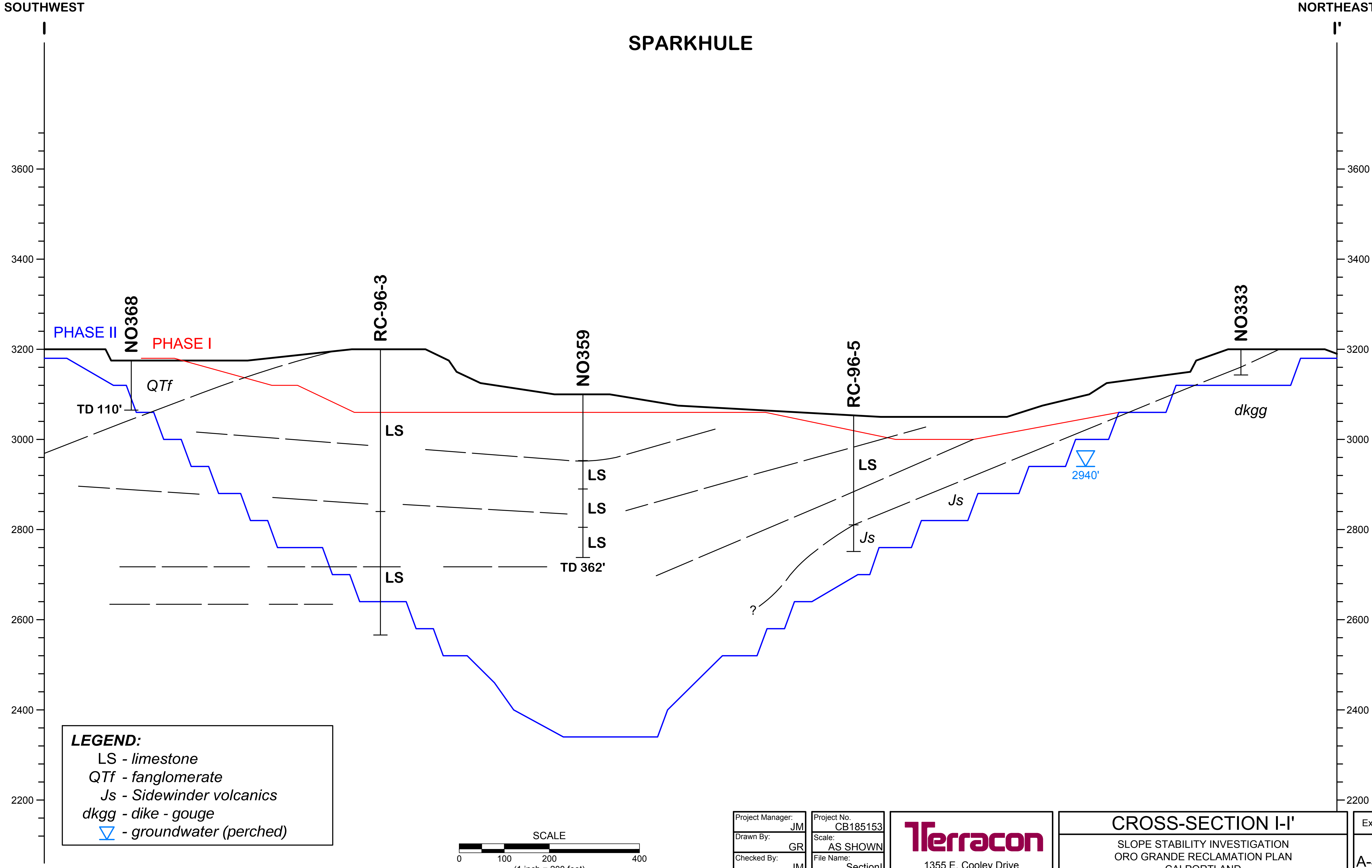
SCALE
0 100 200 400
(1 inch = 200 feet)

Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SectionH
Approved By: JM	Date: February 2019

Terracon
1355 E. Cooley Drive
Colton, CA 92324

CROSS-SECTION H-H'
SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

Exhibit
A-4.8



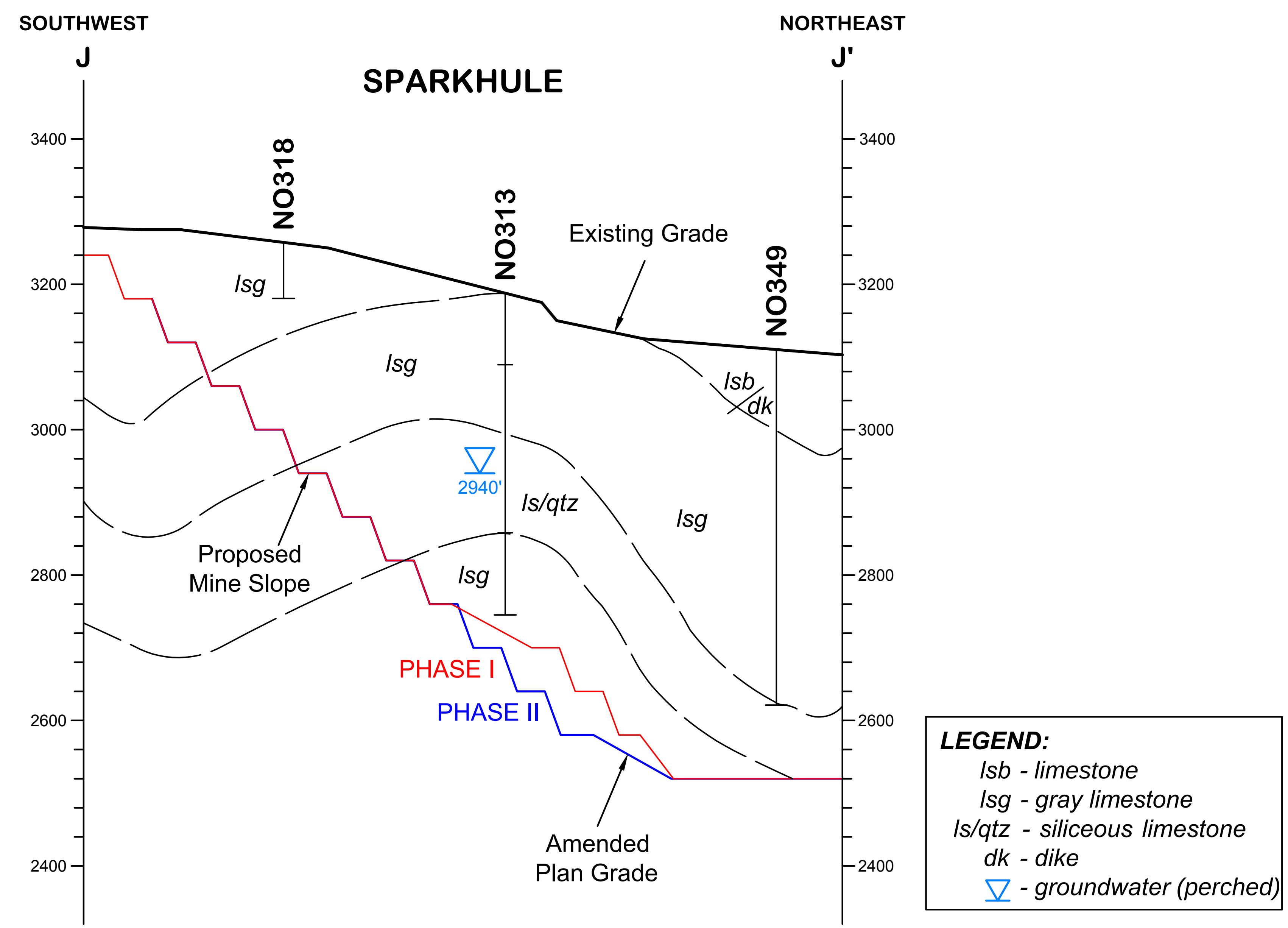
Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SectionI
Approved By: JM	Date: February 2019

Terracon
1355 E. Cooley Drive
Colton, CA 92324

CROSS-SECTION I-I'

SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

Exhibit
A-4.9



Project Manager: JM	Project No. CB185153
Drawn By: GR	Scale: AS SHOWN
Checked By: JM	File Name: SectionI
Approved By: JM	Date: February 2019

Terracon
1355 E. Cooley Drive
Colton, CA 92324

CROSS-SECTION J-J'

SLOPE STABILITY INVESTIGATION
ORO GRANDE RECLAMATION PLAN
CALPORTLAND
ORO GRANDE, SAN BERNARDINO COUNTY, CALIFORNIA

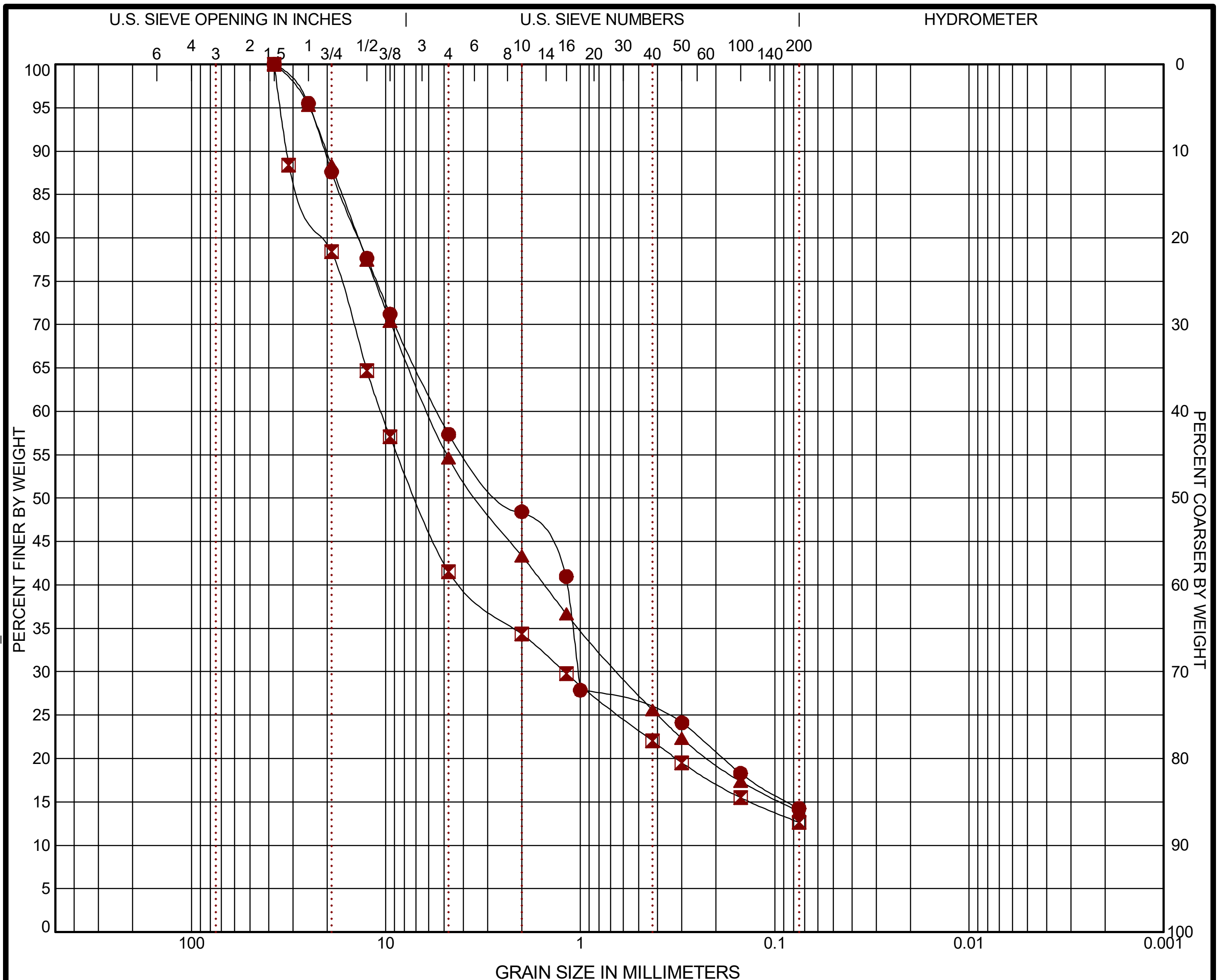
Exhibit
A-4.10

APPENDIX B

LABORATORY DATA

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**#1**	**0 - 1**	**0.0**	**42.6**	**43.1**		**14.2**		**SM**
⊠	**#2**	**0 - 1**	**0.0**	**58.5**	**28.9**		**12.6**		**GM**
▲	**#3**	**0 - 1**	**0.0**	**45.4**	**40.7**		**13.9**		**GM**

	GRAIN SIZE		
	●	⊠	▲
D_{60}	**5.422**	**10.554**	**6.021**
D_{30}	**1.027**	**1.209**	**0.638**
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1 1/2"	**100.0**	**1 1/2"**	**100.0**	**1 1/2"**	**100.0**
1"	**95.51**	**1 1/4"**	**88.4**	**1"**	**95.25**
3/4"	**87.6**	**3/4"**	**78.39**	**3/4"**	**88.34**
1/2"	**77.66**	**1/2"**	**64.72**	**1/2"**	**77.44**
3/8"	**71.21**	**3/8"**	**57.07**	**3/8"**	**70.36**
#4	**57.35**	**#4**	**41.52**	**#4**	**54.61**
#10	**48.44**	**#10**	**34.33**	**#10**	**43.35**
#16	**40.97**	**#16**	**29.79**	**#16**	**36.69**
#18	**27.87**	**#40**	**22.01**	**#40**	**25.59**
#50	**24.11**	**#50**	**19.51**	**#50**	**22.31**
#100	**18.29**	**#100**	**15.49**	**#100**	**17.35**
#200	**14.25**	**#200**	**12.64**	**#200**	**13.92**

SOIL DESCRIPTION
- ● SILTY SAND with GRAVEL (SM)
- ⊠ SILTY GRAVEL with SAND (GM)
- ▲ SILTY GRAVEL with SAND (GM)

REMARKS
- ●
- ⊠
- ▲

PROJECT: CalPortland Oro Grande Amended Reclamation Plan

SITE: 19409 National Trails Highway
Oro Grande, CA

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

PROJECT NUMBER: CB185153

CLIENT: CalPortland Company
Glendora, CA

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 CB185153 CALPORTLAND ORO G.GPJ TERRACON_DATATEMPLATE.GDT 1/14/19

January 23, 2019

Mail To:

Jay Martin
Terracon
1355 E. Cooley Drive Suite C
Colton, CA 92324

email: Jay.Martin@terracon.com

Dear Mr. Martin:

Thank you for consulting TRI/Environmental, Inc. (TRI) - California for your geosynthetics testing needs.
TRI is pleased to submit this large-scale soil direct shear test reports of the laboratory testing for the tests listed below.

Project:		**Soil Direct Shear**
TRI Job Reference Number:		G190061
Materials Tested:		Waste #1 Waste #2 Waste #3
Materials sent by:		Terracon
Test Configurations:	1 2 3	Waste #1 Soil Direct Shear Waste #2 Soil Direct Shear Waste #3 Soil Direct Shear
Test Requested:		Large Scale Direct Shear Test (ASTM D3080 Modified)

If you have any questions or require any additional information, please call us at 1-800-522-4599.

Sincerely,

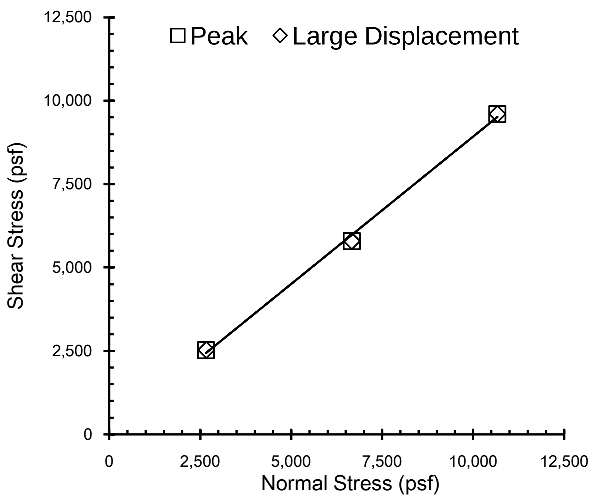
Cora Queja
TRI ENV-California Director

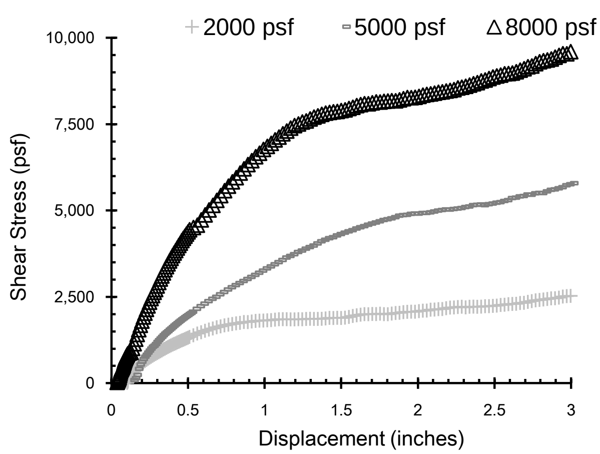
Large Scale Direct Shear Test (ASTM D3080 Modified)

Client: Terracon
Project: Soil Direct Shear

TRI Log #: G190061-1
Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2019
Analysis & Quality Review/Date

Waste #1 Soil Direct Shear





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	41.5	41.5
Y-intercept or Adhesion	psf	81	81
Minimum Secant Angle	Degrees	41.0	41.0

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Waste #1 ω = 3.0%, γ_d = 121.0 pcf	
Lower Box		
Conditioning	Loading applied and interface flooded for 100 minutes prior to shear.	
Shearing Rate	inches/minute	0.04

Specimen No.		-	1	2	3
Normal Stress		psf	2,000	5,000	8,000
Box Edge Dimension		in	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	27	56	84
Peak	Normal Stress	psf	2,658	6,665	10,664
	Shear Stress	psf	2,522	5,791	9,600
	Secant Angle	deg.	43.5	41.0	42.0
Large Displacement	Normal Stress	psf	2,667	6,667	10,667
	Shear Stress	psf	2,530	5,793	9,602
	Secant Angle	deg.	43.5	41.0	42.0

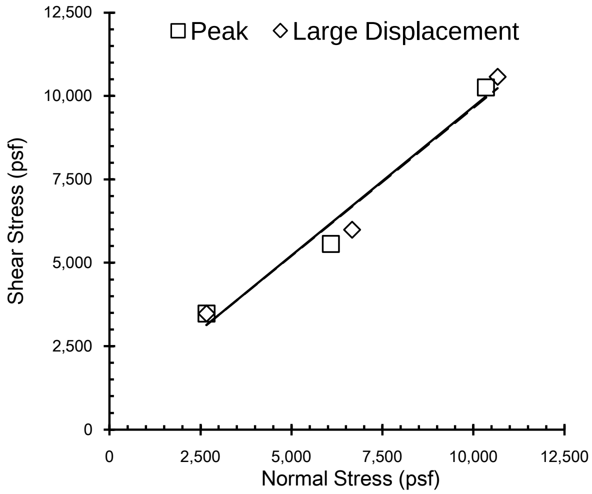
TRI Environmental, Inc.
9063 Bee Caves Rd. – Austin, TX 78733 – USA | Ph: 800.880.TEST or 512.263.2101

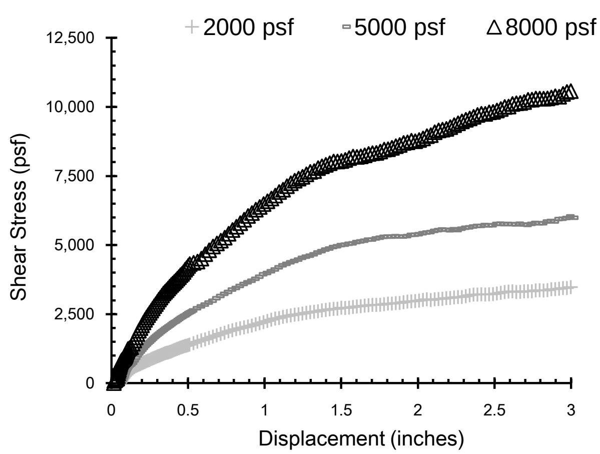
Large Scale Direct Shear Test (ASTM D3080 Modified)

Client: Terracon
Project: Soil Direct Shear

TRI Log #: G190061-2
Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2019
Analysis & Quality Review/Date

Waste #2 Soil Direct Shear





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	41.7	41.6
Y-intercept or Adhesion	psf	758	767
Minimum Secant Angle	Degrees	42.5	41.9

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Waste #2 ω = 2.0%, γ_d = 122.0 pcf	
Lower Box		
Conditioning	Loading applied and interface flooded for 100 minutes prior to shear.	
Shearing Rate	inches/minute	0.04

Specimen No.		-	1	2	3
Normal Stress		psf	2,000	5,000	8,000
Box Edge Dimension		in	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	27	56	84
Peak	Normal Stress	psf	2,666	6,082	10,344
	Shear Stress	psf	3,477	5,565	10,256
	Secant Angle	deg.	52.5	42.5	44.8
Large Displacement	Normal Stress	psf	2,667	6,667	10,667
	Shear Stress	psf	3,478	5,990	10,574
	Secant Angle	deg.	52.5	41.9	44.8

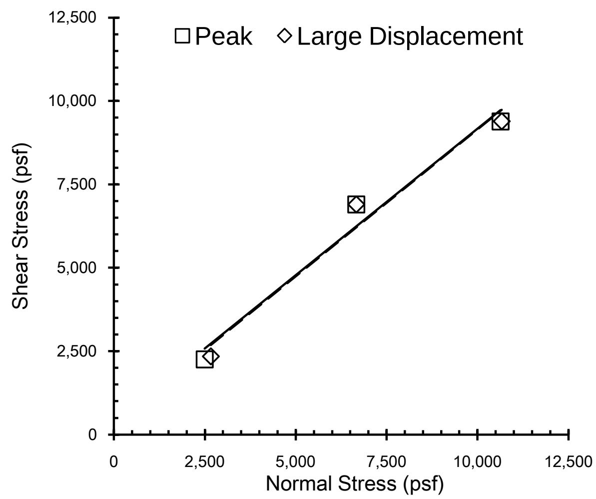
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

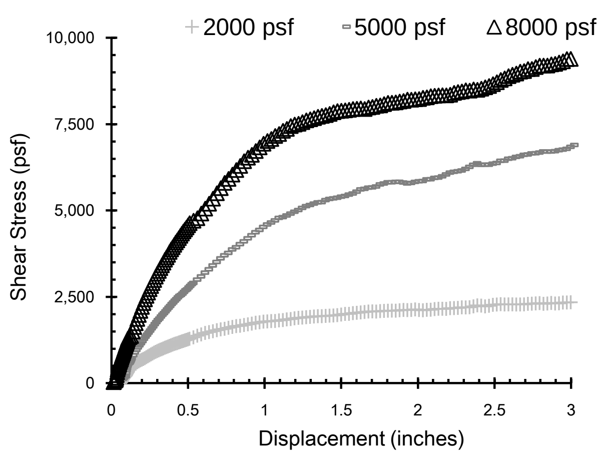
Large Scale Direct Shear Test (ASTM D3080 Modified)

Client: Terracon
Project: Soil Direct Shear

TRI Log #: G190061-3
Jeffrey A. Kuhn, Ph.D., P.E., 1/23/2019
Analysis & Quality Review/Date

Waste #3 Soil Direct Shear





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	41.3	41.4
Y-intercept or Adhesion	psf	382	338
Minimum Secant Angle	Degrees	41.4	41.3

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Waste #3 ω = 3.0%, γ_d = 125.0 pcf	
Lower Box		
Conditioning	Loading applied and interface flooded for 100 minutes prior to shear.	
Shearing Rate	inches/minute	0.04

Specimen No.		-	1	2	3
Normal Stress		psf	2,000	5,000	8,000
Box Edge Dimension		in	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	27	56	84
Peak	Normal Stress	psf	2,497	6,666	10,634
	Shear Stress	psf	2,253	6,898	9,386
	Secant Angle	deg.	42.1	46.0	41.4
Large Displacement	Normal Stress	psf	2,667	6,667	10,667
	Shear Stress	psf	2,344	6,899	9,392
	Secant Angle	deg.	41.3	46.0	41.4

TRI Environmental, Inc.
9063 Bee Caves Rd. – Austin, TX 78733 – USA | Ph: 800.880.TEST or 512.263.2101

APPENDIX C

KINEMATIC STABILITY CALCULATIONS

Discontinuity Data – CP Superior-Mack's Peak-Oro Grande Canyon						
Discontinuity No.	**Dip**	**Dip Direction**	**Type**	**Location**	**Geologic Unit**	**Continuity**
1	40	385	B	Sup 1	€z	5
2	54	061	J		€z	
3	68	196	J		€Zwc	3
4	36	040	B		€Zwc	5
5	20	003	J		Schist	3
6	80	340	J		€cl	4
7	35	300	B		€cl	5
8	36	070	Basal shear	MP 1	€cl	3
9	31	120	J		€cl	1
10	54	355	J		€cl	1
11	27	215	Basal shear	MP 2	€cl	5
12	67	153	B	OGC 1	€cl	5
13	41	164	J		€cl	3
14	38	030	J		€cl	3
15	80	256	J		€cl	3
16	36	150	J		€cl	3
17	43	243	B		€cl	5
18	65	160	J		€cl	3
19	70	190	J		€cl	3
20	5	251	J		€cl	3
21	48	039	J		€cl	2
22	78	215	J		€cl	3
23	78	171	B		€cl	5
24	33	143	B		€cl	4
25	68	166	B		€cl	5
26	43	243	B		€cl	5
27	72	168	B		€cl	5
28	33	256	J	OGC 2	€Zwcl	3
29	26	187	J		€Zwcl	3
30	81	030	J		€Zwcl	2
31	77	150	J		€Zwcl	3
32	68	036	J		€Zwcl	2
33	70	037	J		€Zwcl	3
34	33	050	J		€Zwcl	3
35	80	141	J		€Zwcl	2

* C1 - discontinuous (less than 3 ft.); C2 - slightly continuous (3 to 10 feet); C3 - moderately continuous (10 to 30 feet); C4 - highly continuous (30 to 100 feet); C5 - very continuous (greater than 100 feet).
Based on Department of the Interior - Bureau of Reclamation, Engineering Geology Field Manual (2nd edition 1998)

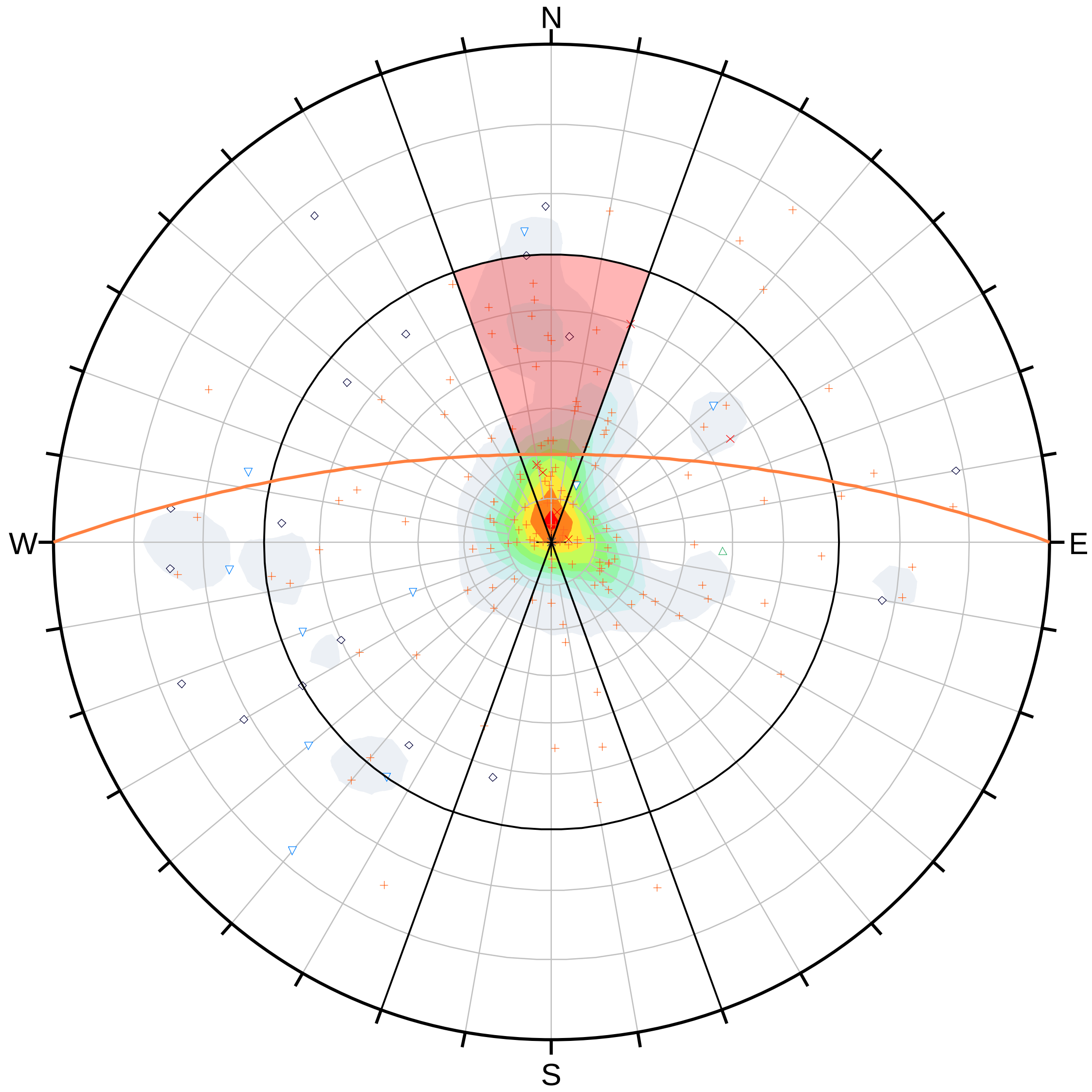
Discontinuity Data – CP Sparkhule						
Discontinuity No.	**Dip**	**Dip Direction**	**Type**	**Location**	**Geologic Unit**	**Continuity**
1	26	355	Shr	S 1	Mmc	5
2	88	080	J		Mmc	2
3	67	020	J		Mmc	3
4	19	274	J		Mmc	2
5	75	086	J		Mmc	2
6	86	357	J		Mmc	3
7	83	011	F		Mmc	4
8	22	010	J		Mmc	3
9	45	060	F	S 2	Mmc v. Js.	5
10	40	268	J		Js	2
11	42	052	J		Js	3
12	83	305	J		Js	4
13	83	137	J		Js	4
14	48	053	J		Js	3
15	16	294	J		Js	2
16	63	026	J		Js	3
17	60	010	J		Mmc	3
18	31	263	J		Mmc	3
19	44	050	Shr		Mmc	
20	76	110	J		Mmc	2
21	63	330	J		Mmc	4
22	67	128	J		Mmc	4
23	80	268	J		Mmc	2
24	75	359	J		Mmc	3
25	68	240	J		Mmc	3
26	40	020	F		Mmc	4
27	43	281	J	S 3	Mmc	5
28	23	040	J		Mmc	4
29	25	230	Shr	S 4	Mmc	4
30	34	250	Shr		Mmc	4
31	57	250	Shr		Mmc	3
32	59	011	J		Mmc	3
33	30	240	B		Mmc	4
34	86	014	J		Mmc	3
35	43	012	J		Mmc	3
36	78	225	J		Mmc	2
37	12	220	Shr		Trend on slide	
38	74	353	F	S 5		4
39	30	215	Shr			4
40	70	221	J		Pbs	3
41	35	356	J		Pbs	3
42	71	172	J	S 6	Mmc	3
43	22	100	B		Mmc	4
44	31	220	J		Mmc	3
45	86	046	J		Mmc	3
46	24	265	Shr	S 7	Trend on slide	5
47	13	249	B		Pbs	4
48	42	310	J		Pbs	5
49	86	082	F		Pbs	4
50	58	010	J		Pbs	5
51	72	349	F		Pbs	5
52	73	335	J		Pbs	3

53	45	359	J		Pbs	2
54	77	118	J		Pbs	2
55	11	080	B		Pbs	4
56	86	273	J		Pbs	3
57	51	015	J		Pbs	3
58	81	002	J	S-7	Pbs	3
59	84	094	J		Pbs	3
60	22	359	B		Pbs	4
61	81	354	J		Pbs	3
62	30	355	B		Pbs	4
63	36	325	B		Pbs	4
64	76	264	J		Pbs	5
65	81	340	J		Mmc	2
66	86	256	J		Mmc	3
67	16	265	J	S 8	Mmc	3
68	46	360	J		Mmc	4
69	82	270	J		Mmc	3
S-9 – no data recorded						
70	84	085	J		Pbs	2
71	55	163	J		Pbs	2
72	45	179	J	S-10	Pbs	2
73	88	090	J		Pbs	3
74	42	106	J		Pbs	2
75	73	351	J		Pbs	2
76	68	354	J		Pbs	3
77	86	100	J		Pbs	3
78	52	093	Fault			4
79	33	274	B		Pbs	5
80	86	300	J		Pbs	3
81	80	012	J		Pbs	4
82	46	285	J		Pbs	4
83	38	194	B		Pbs	5
84	38	356	J	S-11	Pbs	4
85	38	345	J		Pbs	3
86	37	215	B		Pbs	5
87	56	064	J		Pbs	3
88	78	113	J		Pbs	5
89	12	085	J		Pbs	3
90	48	328	J		Pbs	4
91	79	062	J		Pbs	2
92	74	305	J		Pbs	5
93	66	142	J		Pbs	2
94	23	078	J		Pbs	3
95	73	232	J		Pbs	3
96	12	324	B		Pbs	5
97	77	121	J		Pbs	4
98	88	353	J		Pbs	4
99	19	099	J	S-12	Pbs	4
100	34	261	J		Pbs	3
101	66	308	J		Pbs	2
102	76	180	J		Pbs	3
103	84	179	J		Pbs	2
104	11	036	J		Pbs	3
105	35	308	B		Pbs	5
106	81	085	J		Pbs	2
107	85	276	J	S-13	Mmc	4

108	42	240	J	S-13	Mmc	2
109	86	178	J		Mmc	3
110	58	091	J		Mmc	2
111	48	022	J		Mmc	2
112	72	350	J		Mmc	3
113	67	172	J		Mmc	3
114	57	278	J		Mmc	2
115	67	001	J		Mmc	2
116	76	198	J		Mmc	3
117	25	061	J		Mmc	5
118	74	334	J		Mmc	3
119	62	026	J		Mmc	4
120	51	230	J		Mmc	3
121	40	245	B		Mmc	5
122	76	354	J	S-14	Pbs	3
123	88	269	J		Pbs	2
124	77	358	J		Pbs	3
125	15	266	B		Pbs	5
126	32	339	J	S-15	Pbs	3
127	73	130	J		Pbs	2
128	58	025	J		Pbs	3
129	15	206	J		Pbs	3
130	70	013	J		Pbs	3
131	77	096	J		Pbs	3
132	41	355	J		Pbs	3
133	33	093	J		Pbs	3
134	87	060	J		Pbs	3
135	47	350	J		Pbs	3
136	75	128	J		Pbs	2
137	34	120	J		Pbs	2
138	43	079	J		Pbs	2
139	75	105	J		Pbs	3
140	18	094	J		Pbs	2
141	51	355	J		Pbs	3
142	60	025	J		Pbs	2
143	67	358	J	S-16	Pbs	3
144	80	301	J		Pbs	3
145	19	032	J		Pbs	2
146	87	359	J		Pbs	3
147	43	344	J		Pbs	3
148	45	005	B		Pbs	4
149	82	290	J		Pbs	2
150	77	076	J		Pbs	3
151	26	283	Shr		Pbs	5
152	73	003	J		Pbs	4
153	63	341	J		Pbs	3
154	18	163	J		Pbs	2
155	75	291	J		Pbs	4
156	15	275	B	S-17	Pbs	5
157	76	135	J		Pbs	3
158	75	021	J		Pbs	3
159	76	024	Shr		Pbs	5
160	19	240	B		Pbs	5
161	29	081	J		Js	3
162	76	111	J		Js	2
163	78	011	J		Pbs	4

164	44	166	J	S-17	Pbs	3
165	70	030	J	Cut	Jg	3
166	74	001	J		Jg	2
167	57	120	J		Jg	3
168	80	030	J		Jg	3
169	76	289	J		Jg	2
170	47	200	J		Jg	3
171	79	020	J		Jg	3
172	74	305	J		Jg	3
173	66	120	J		Jg	2
174	34	170	J		Jg	2
175	55	106	J		Jg	2
176	53	320	J		Jg	2
177	53	110	J		Jg	2
178	72	265	J		Jg	2
179	80	323	J		Jg	3
180	63	120	J		Jg	3
181	26	220	J		Jg	2

* C1 - discontinuous (less than 3 ft.); C2 - slightly continuous (3 to 10 feet); C3 - moderately continuous (10 to 30 feet); C4 - highly continuous (30 to 100 feet); C5 - very continuous (greater than 100 feet).
Based on Department of the Interior - Bureau of Reclamation, Engineering Geology Field Manual (2nd edition 1998)



Symbol	TYPE	Quantity
◇	B	17
×	F	6
△	Fault	1
+	J	147
▽	Shr	10

Color	Density Concentrations
	0.00 - 1.50
	1.50 - 3.00
	3.00 - 4.50
	4.50 - 6.00
	6.00 - 7.50
	7.50 - 9.00
	9.00 - 10.50
	10.50 - 12.00
	12.00 - 13.50
	13.50 - 15.00

Contour Data	Dip Vectors
Maximum Density	14.29%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	70
Slope Dip Direction	0
Friction Angle	30°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	22	181	12.15%

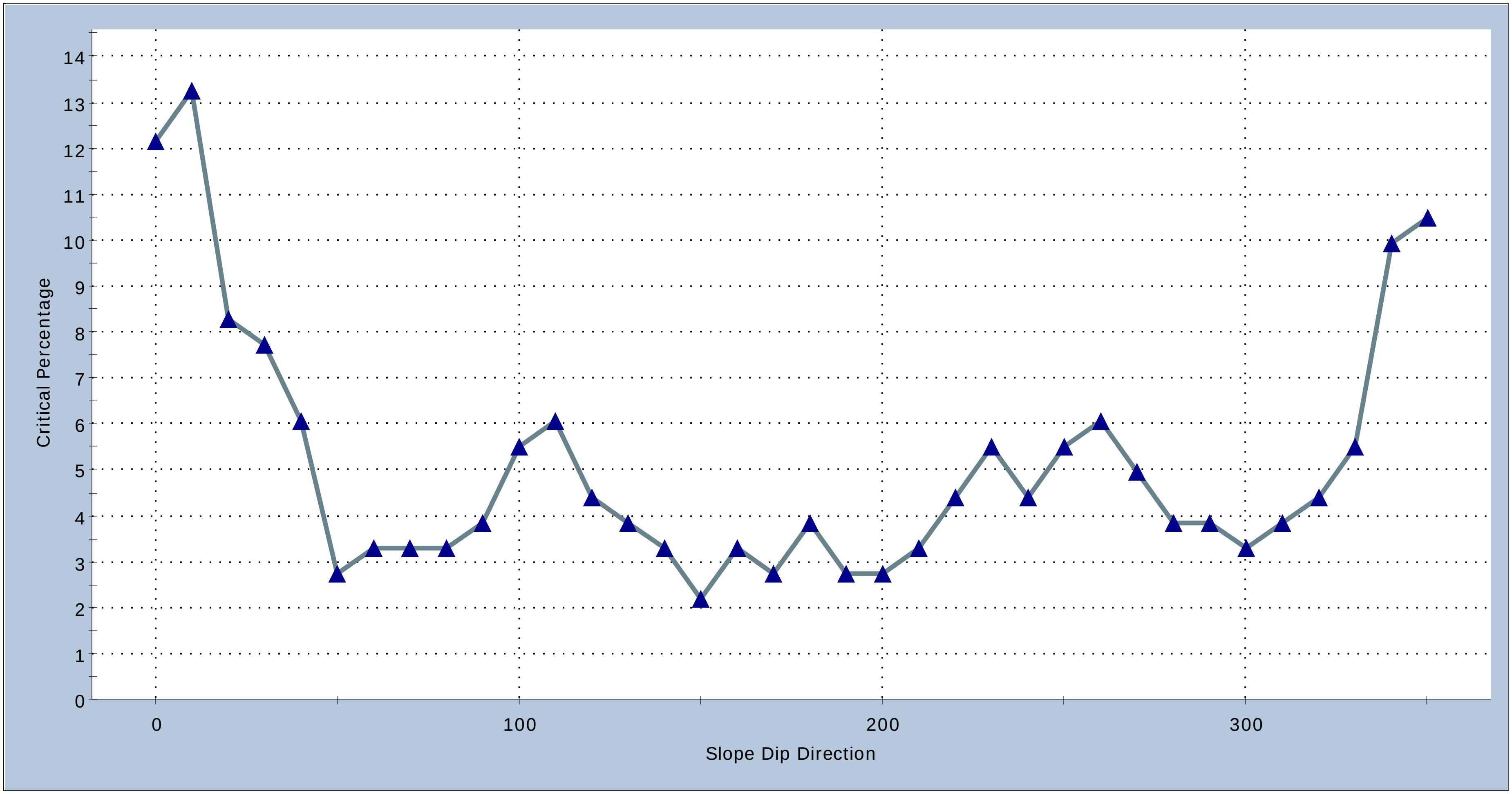
Plot Mode	Dip Vectors
Vector Count	181 (181 Entries)
Hemisphere	Lower
Projection	Equal Angle

Terracon

DIPS 7.014

Project	Oro Grande Amend Rec Plan		
Analysis Description	Kinematic Evaluation		
Drawn By	Terracon	*Author*	JMc
File Name	Sparkhule data.dips7	*Date*	2/18/2019

Planar Sliding: Critical Percentage vs. Slope Dip Direction



Mean Values

Slope Dip = 70 Slope Dip Direction = 0 Friction Angle = 30 Lateral Limit = 20

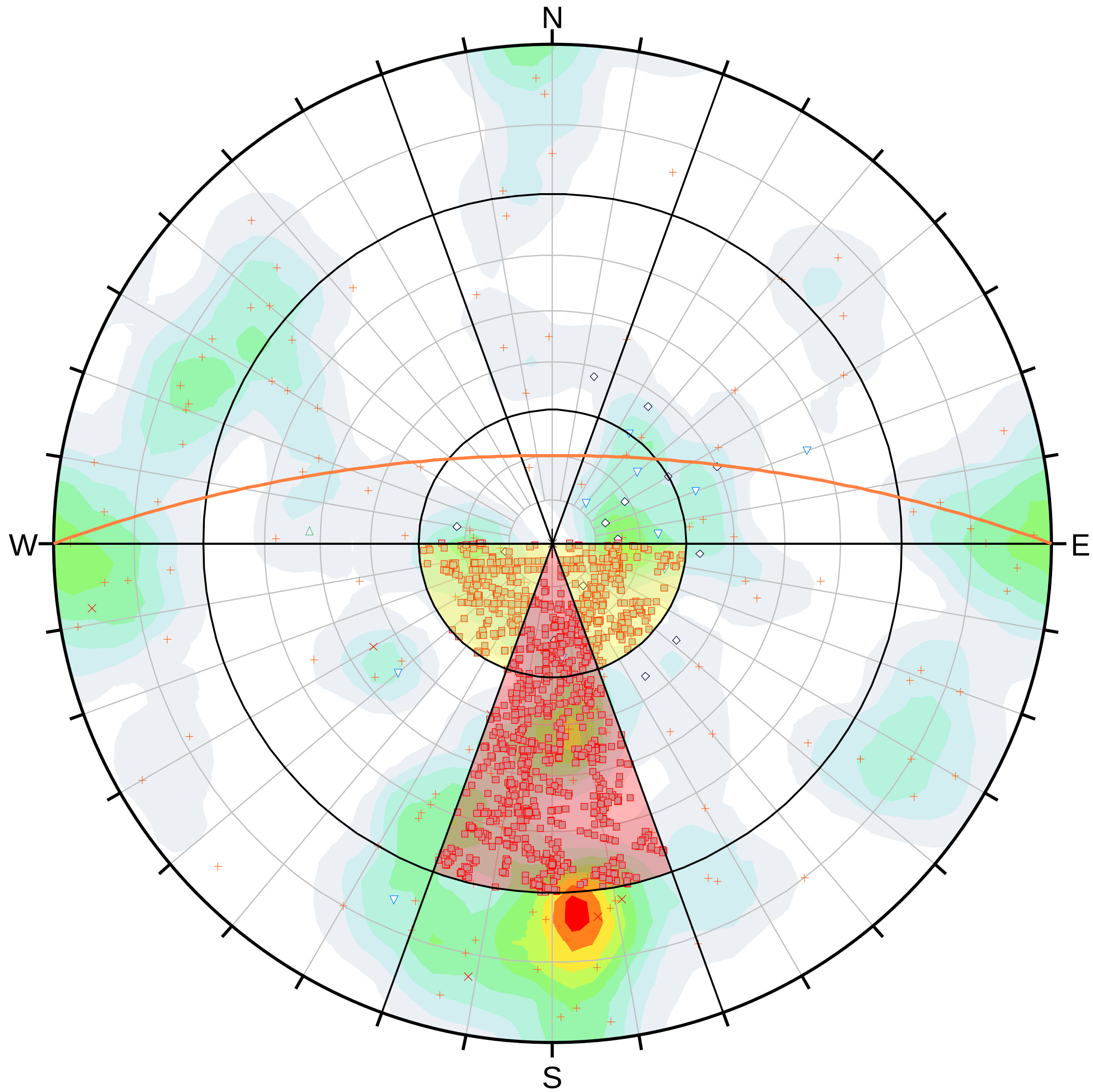
Terracon	*Project*		
	Analysis Description		
	Drawn By	*Author*	
DIPS 7.014	*File Name* Sparkhule data.dips7	*Date*	2/6/2019

Wedge Sliding: Critical Percentage vs. Slope Dip Direction

Mean Values

Slope Dip = 70 Slope Dip Direction = 0 Friction Angle = 30 Lateral Limit = 20

Terracon	*Project*		
	Analysis Description		
	Drawn By	*Author*	
DIPS 7.014	*File Name* Sparkhule data wedge.dips7	*Date* 2/6/2019	



Symbol	TYPE	Quantity
◇	B	17
×	F	6
△	Fault	1
+	J	147
▽	Shr	10
Symbol	**Feature**	
▫	Critical Intersection	

Color	Density Concentrations
	0.00 - 0.60
	0.60 - 1.20
	1.20 - 1.80
	1.80 - 2.40
	2.40 - 3.00
	3.00 - 3.60
	3.60 - 4.20
	4.20 - 4.80
	4.80 - 5.40
	5.40 - 6.00

Contour Data	Pole Vectors
Maximum Density	5.74%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Toppling
Slope Dip	70
Slope Dip Direction	0
Friction Angle	30°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	908	16289	5.57%
Oblique Toppling (Intersection)	463	16289	2.84%
Base Plane (All)	39	181	21.55%

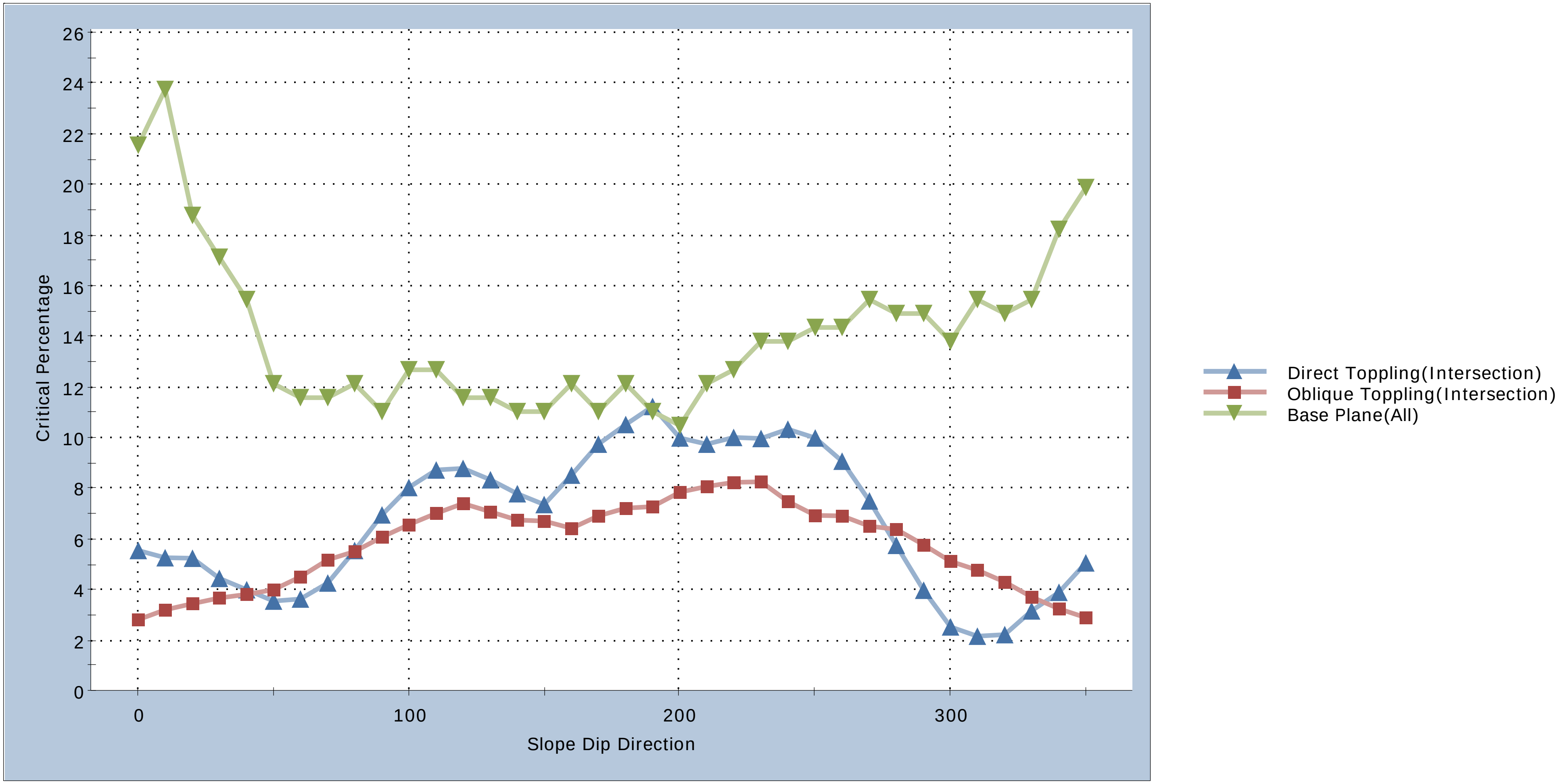
Plot Mode	Pole Vectors
Vector Count	181 (181 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	16289
Hemisphere	Lower
Projection	Equal Angle

Terracon

DIPS 7.014

Project	Oro Grande Amend Rec Plan		
Analysis Description	Kinematic Evaluation		
Drawn By	Terracon	*Author*	JMc
File Name	Sparkhule data topple.dips7	*Date*	2/6/2019

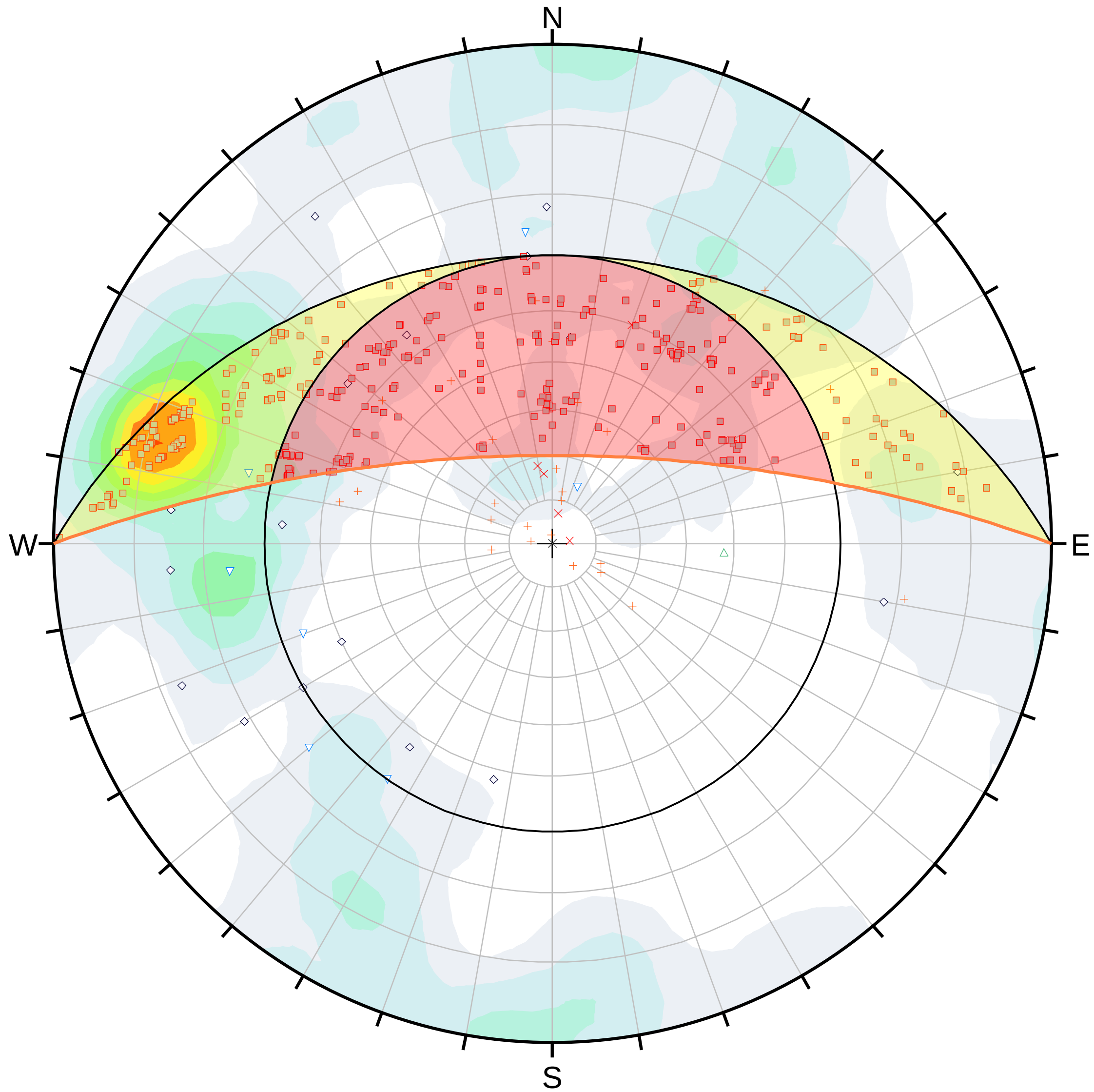
Direct Toppling: Critical Percentage vs. Slope Dip Direction



Mean Values

Slope Dip = 70 Slope Dip Direction = 0 Friction Angle = 30 Lateral Limit = 20

Terracon	*Project*		
	Analysis Description		
	Drawn By	*Author*	
DIPS 7.014	*File Name* Sparkhule data topple.dips7	*Date*	2/6/2019



Symbol	TYPE	Quantity
◇	B	17
×	F	6
△	Fault	1
+	J	25
▽	Shr	7
Symbol	**Feature**	
▫	Critical Intersection	

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Intersections
Maximum Density	7.26%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	70		
Slope Dip Direction	0		
Friction Angle	30°		
	Critical	Total	%
Wedge Sliding	364	1540	23.64%

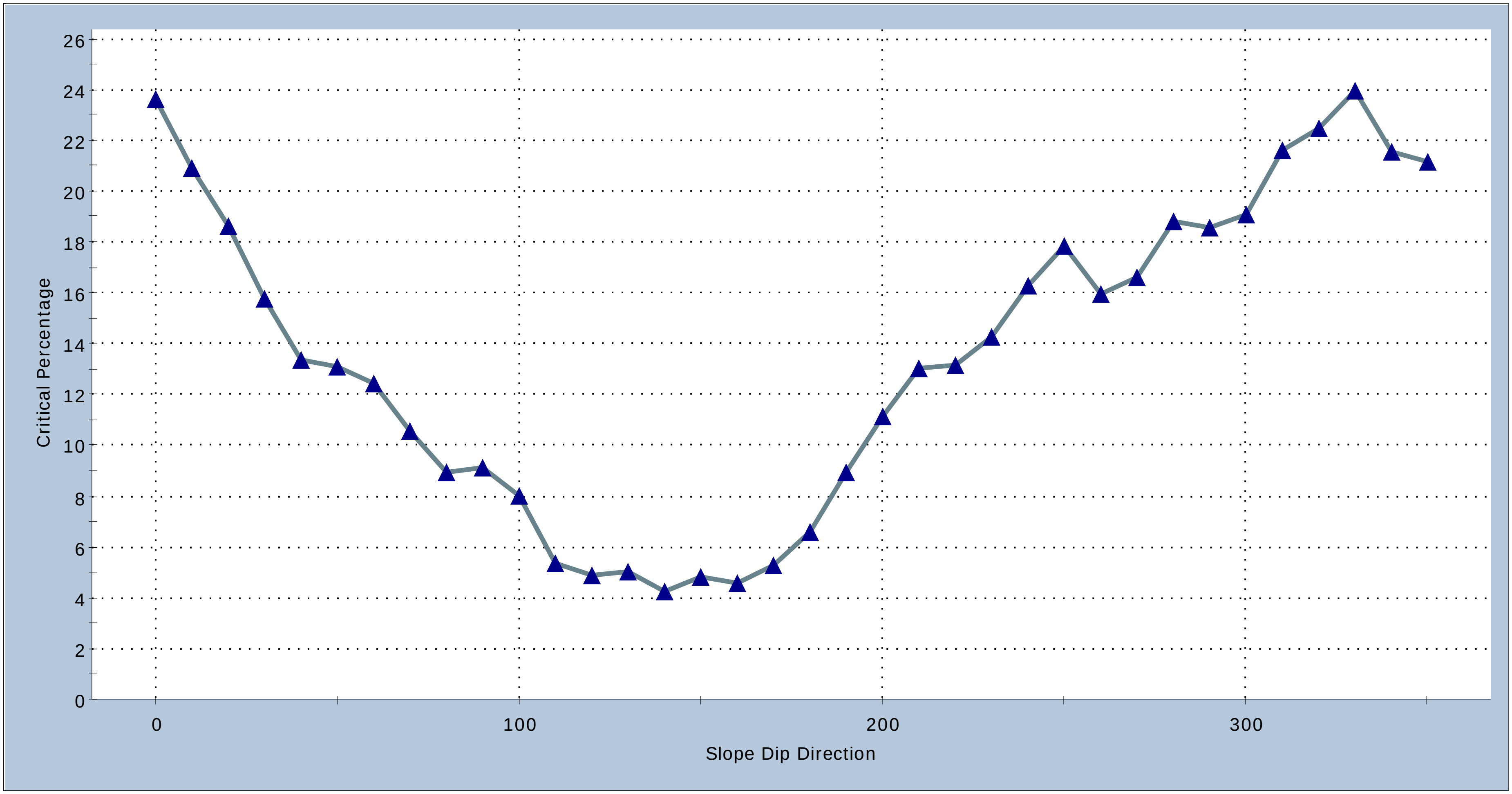
Plot Mode	Dip Vectors
Vector Count	56 (56 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	1540
Hemisphere	Lower
Projection	Equal Angle

Terracon

Project			
Analysis Description			
Drawn By		*Author*	
File Name	Sparkhule data cont 4&5 vectors wedge.dips7	*Date*	2/6/2019

DIPS 7.014

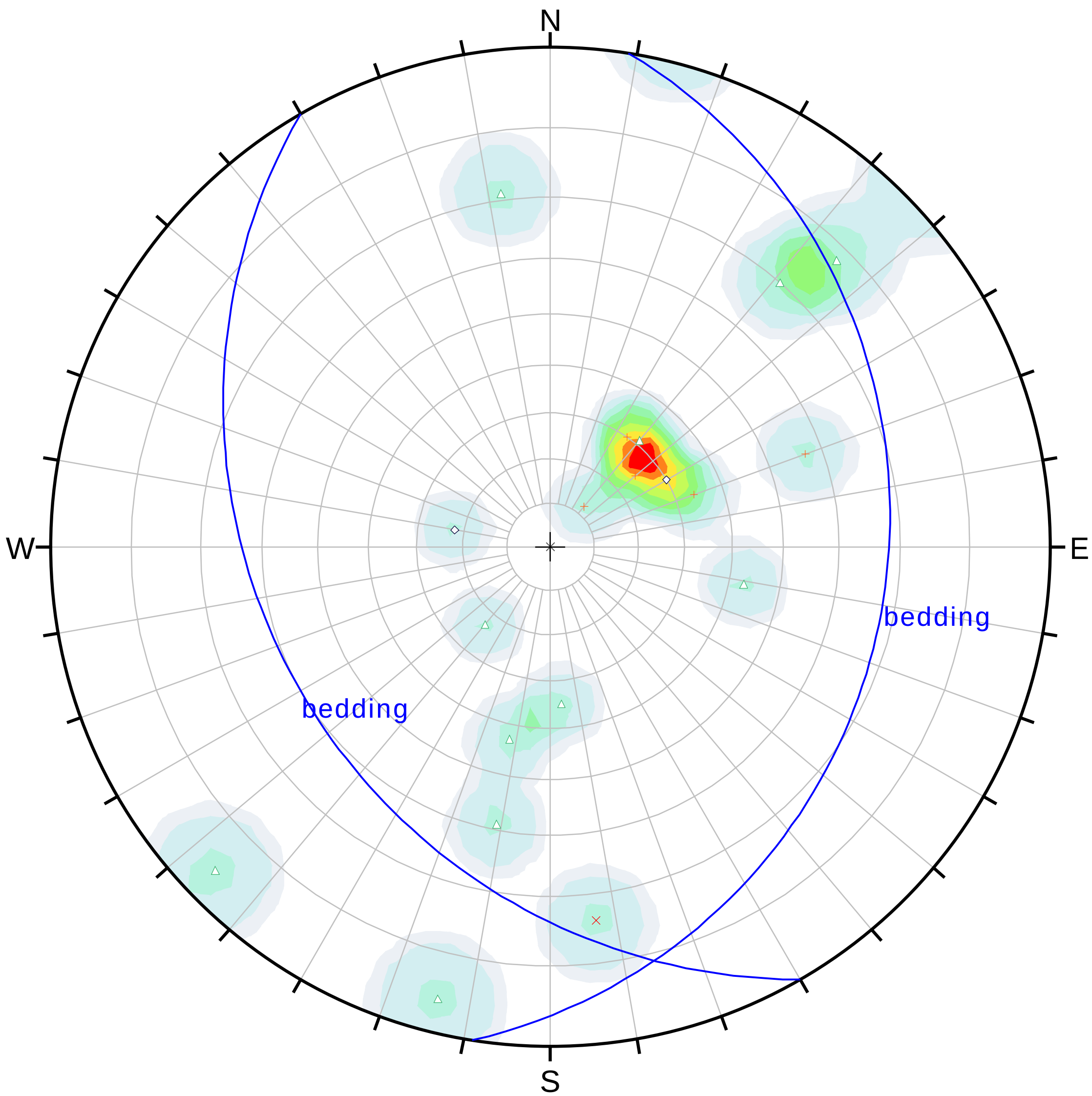
Wedge Sliding: Critical Percentage vs. Slope Dip Direction



Mean Values

Slope Dip = 70 Slope Dip Direction = 0 Friction Angle = 30 Lateral Limit = 20

Terracon	Project		
	Analysis Description		
	Drawn By	Author	
DIPS 7.014	File Name Sparkhule data cont 4&5 vectors wedge.dips7	Date	2/6/2019

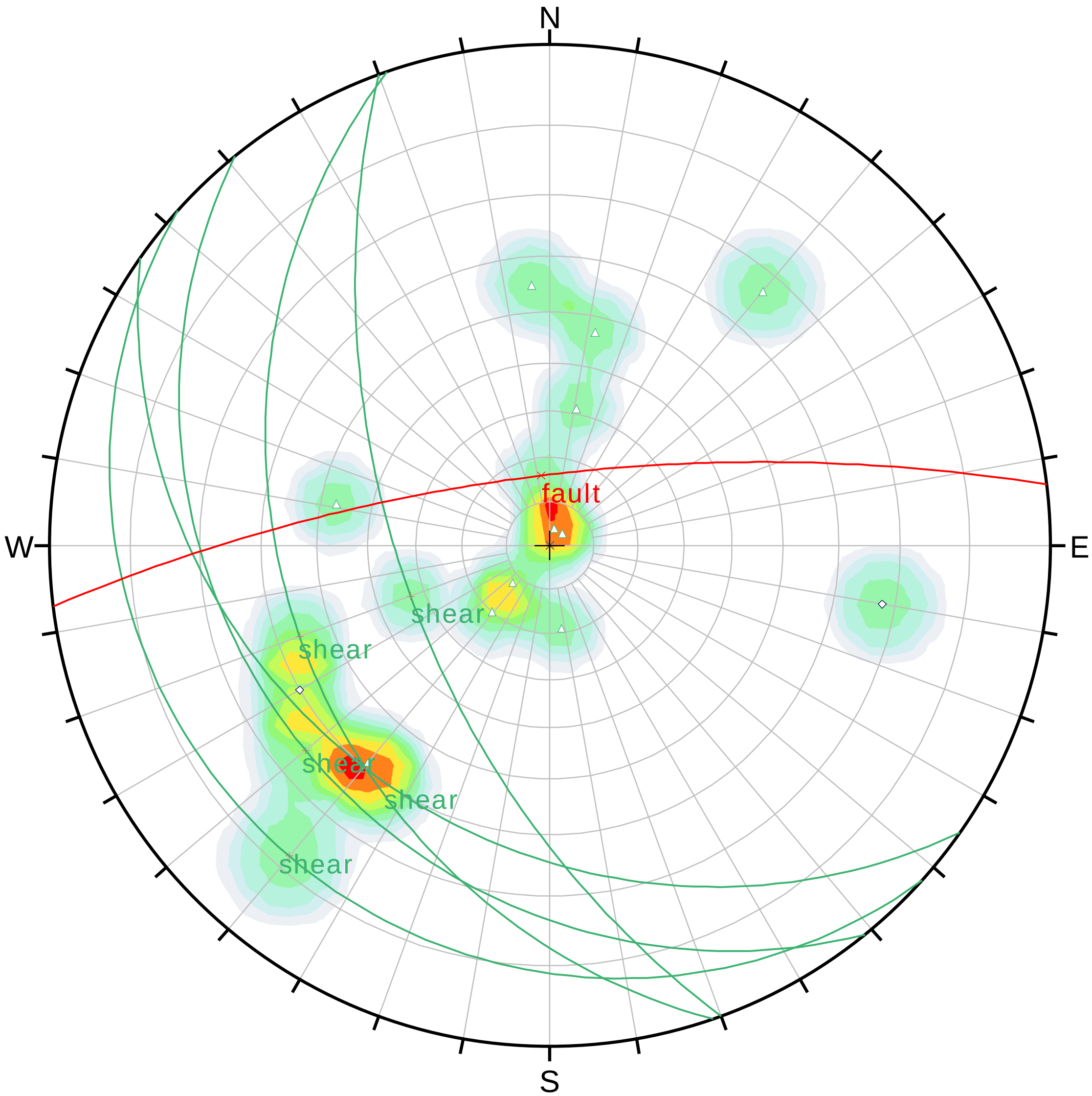


Symbol	TYPE	Quantity
◇	B	2
×	F	1
△	J	11
+	Shr	5

Color	Density Concentrations
	0.00 - 1.70
	1.70 - 3.40
	3.40 - 5.10
	5.10 - 6.80
	6.80 - 8.50
	8.50 - 10.20
	10.20 - 11.90
	11.90 - 13.60
	13.60 - 15.30
	15.30 - 17.00
Contour Data	Pole Vectors
Maximum Density	16.80%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	19 (19 Entries)
Hemisphere	Lower
Projection	Equal Angle

Terracon	*Project* Oro Grande Amend Rec Plan		
	Analysis Description Kinematic Evaluation		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sparkhule data northside bedding.dips7	*Date* 2/6/2019	



Symbol	TYPE	Quantity
◇	B	2
×	F	1
△	J	11
+	Shr	5

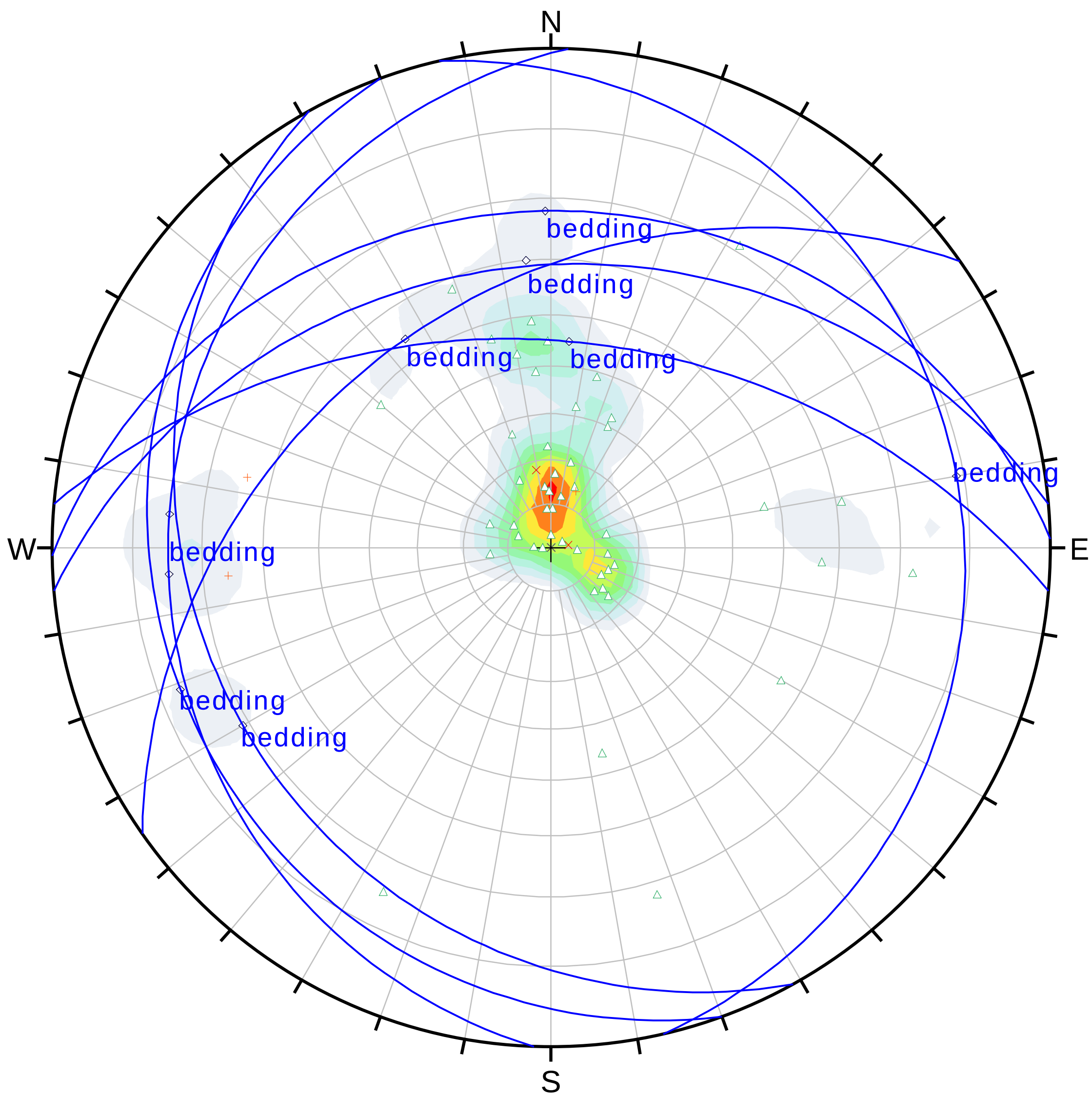
Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Dip Vectors
Maximum Density	11.99%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Dip Vectors
Vector Count	19 (19 Entries)
Hemisphere	Lower
Projection	Equal Angle

Project	Oro Grande Amend Rec Plan		
Analysis Description	Kinematic Evaluation		
Drawn By	Terracon	*Author*	JMc
File Name	Sparkhule data northside.dips7	*Date*	2/6/2019

DIPS 7.014



Symbol	TYPE	Quantity
◇	B	9
×	F	2
△	J	48
+	Shr	3

Color	Density Concentrations
	0.00 - 1.70
	1.70 - 3.40
	3.40 - 5.10
	5.10 - 6.80
	6.80 - 8.50
	8.50 - 10.20
	10.20 - 11.90
	11.90 - 13.60
	13.60 - 15.30
	15.30 - 17.00

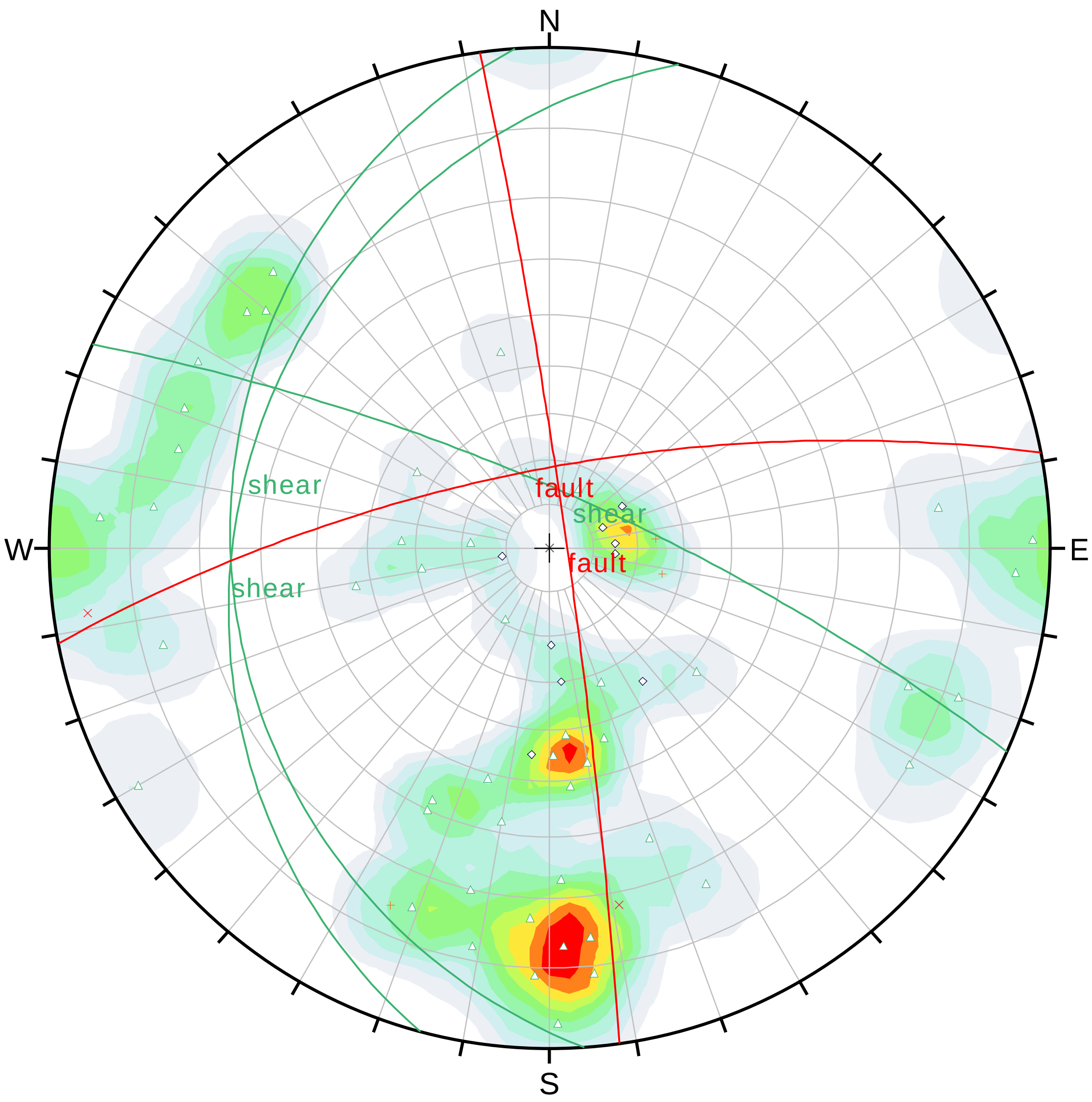
Contour Data	Dip Vectors
Maximum Density	16.07%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Dip Vectors
Vector Count	62 (62 Entries)
Hemisphere	Lower
Projection	Equal Angle

Terracon

Project	Oro Grande Amend Rec Plan		
Analysis Description	Kinematic Evaluation		
Drawn By	Terracon	*Author*	JMc
File Name	Sparkhule data southside bedding.dips7	*Date*	2/6/2019

DIPS 7.014



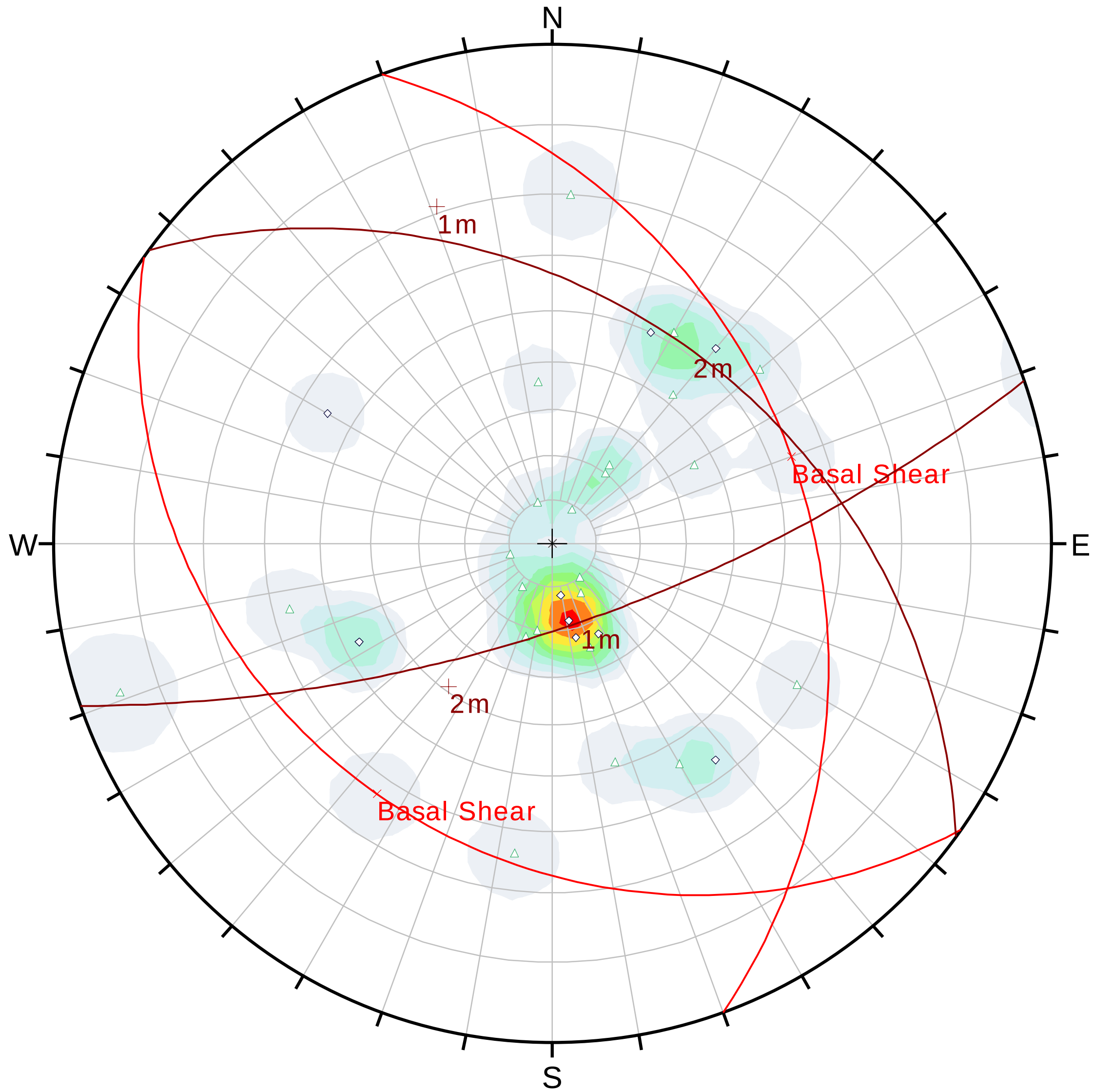
Symbol	TYPE	Quantity
◇	B	9
×	F	2
△	J	48
+	Shr	3

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	8.00%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	62 (62 Entries)
Hemisphere	Lower
Projection	Equal Angle

Terracon	*Project* Oro Grande Amend Rec Plan		
	Analysis Description Kinematic Evaluation		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sparkhule data southside shears and faults.dips7	*Date* 2/6/2019	



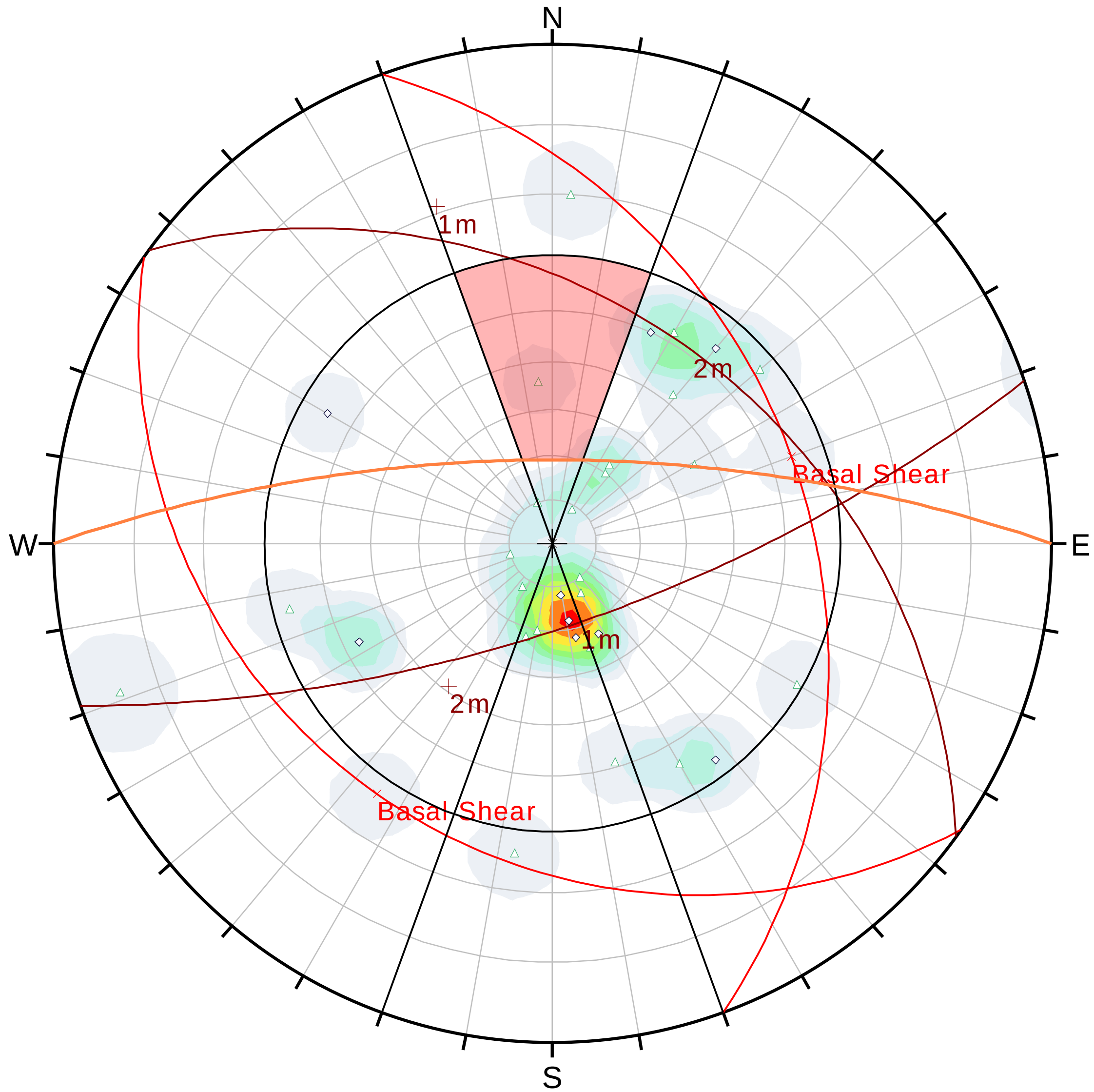
Symbol	TYPE	Quantity
◇	B	10
×	Basal shear	2
△	J	23

Color	Density Concentrations
	0.00 - 1.60
	1.60 - 3.20
	3.20 - 4.80
	4.80 - 6.40
	6.40 - 8.00
	8.00 - 9.60
	9.60 - 11.20
	11.20 - 12.80
	12.80 - 14.40
	14.40 - 16.00

Contour Data	Dip Vectors
Maximum Density	15.80%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Dip Vectors
Vector Count	35 (35 Entries)
Hemisphere	Lower
Projection	Equal Angle

Terracon	*Project* Oro Grande Amend Reclamation		
	Analysis Description Kinematic Analysis		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sup Macks OGC dip vectors.dips7	*Date* 2/6/2019	



Symbol	TYPE	Quantity
◇	B	10
×	Basal shear	2
△	J	23

Color	Density Concentrations
	0.00 - 1.60
	1.60 - 3.20
	3.20 - 4.80
	4.80 - 6.40
	6.40 - 8.00
	8.00 - 9.60
	9.60 - 11.20
	11.20 - 12.80
	12.80 - 14.40
	14.40 - 16.00

Contour Data	Dip Vectors
Maximum Density	15.80%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	71
Slope Dip Direction	0
Friction Angle	30°
Lateral Limits	20°

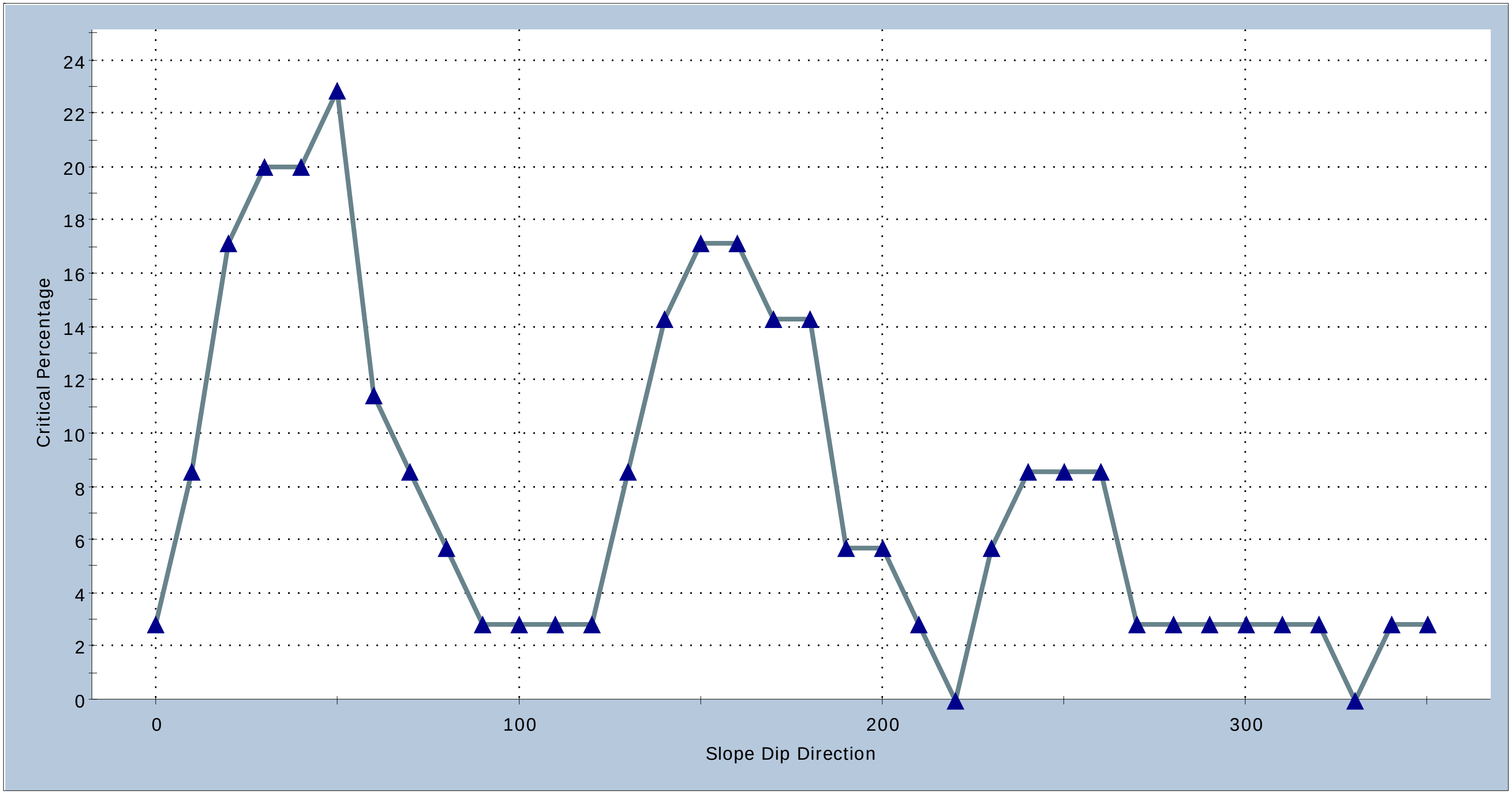
	Critical	Total	%
Planar Sliding (All)	1	35	2.86%

Plot Mode	Dip Vectors
Vector Count	35 (35 Entries)
Hemisphere	Lower
Projection	Equal Angle

Project	Oro Grande Amend Reclamation		
Analysis Description	Kinematic Analysis		
Drawn By	Terracon	*Author*	JMc
File Name	Sup Macks OGC planar.dips7	*Date*	2/6/2019

DIPS 7.014

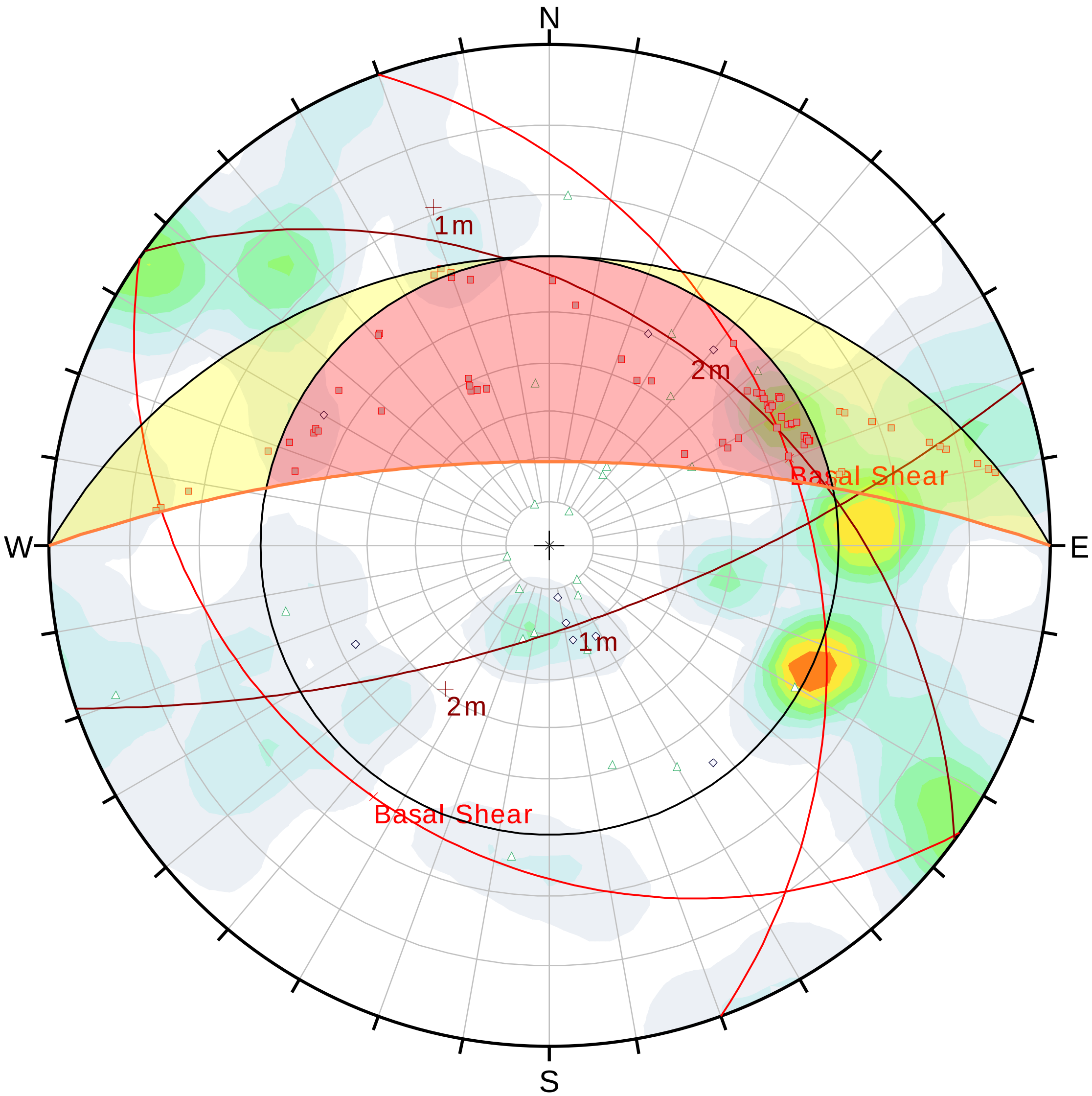
Planar Sliding: Critical Percentage vs. Slope Dip Direction



Mean Values

Slope Dip = 71 Slope Dip Direction = 0 Friction Angle = 30 Lateral Limit = 20

Terracon	*Project* Oro Grande Amend Reclamation		
	Analysis Description Kinematic Analysis		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sup Macks OGC planar.dips7	*Date* 2/6/2019	



Symbol	TYPE	Quantity
◇	B	10
×	Basal shear	2
△	J	23
Symbol	**Feature**	
▫	Critical Intersection	

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Intersections
Maximum Density	7.18%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	71
Slope Dip Direction	0
Friction Angle	30°

	Critical	Total	%
Wedge Sliding	79	594	13.30%

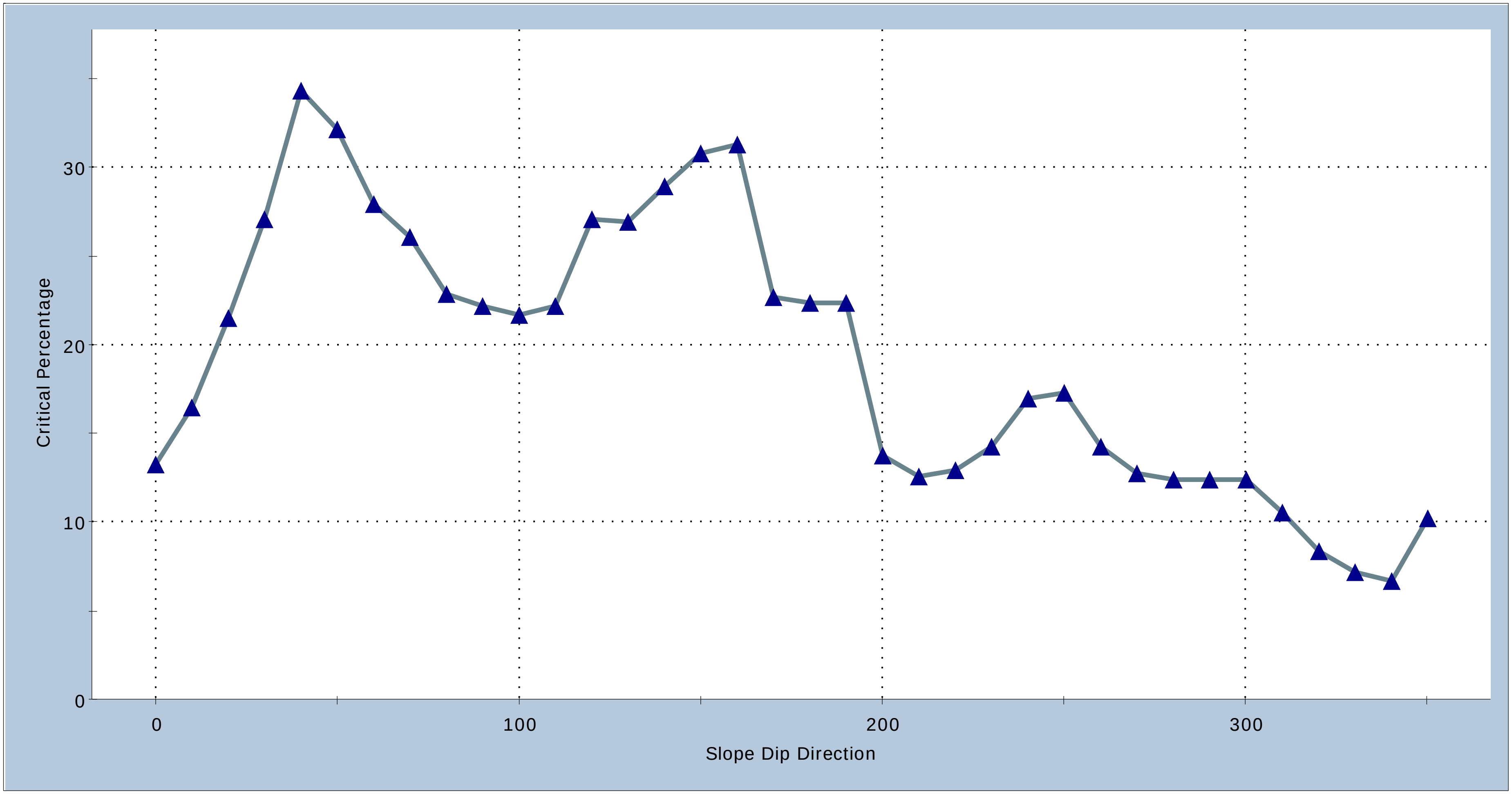
Plot Mode	Dip Vectors
Vector Count	35 (35 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	594
Hemisphere	Lower
Projection	Equal Angle

Terracon

Project	Oro Grande Amend Reclamation		
Analysis Description	Kinematic Analysis		
Drawn By	Terracon	*Author*	JMc
File Name	Sup Macks OGC wedge.dips7	*Date*	2/6/2019

DIPS 7.014

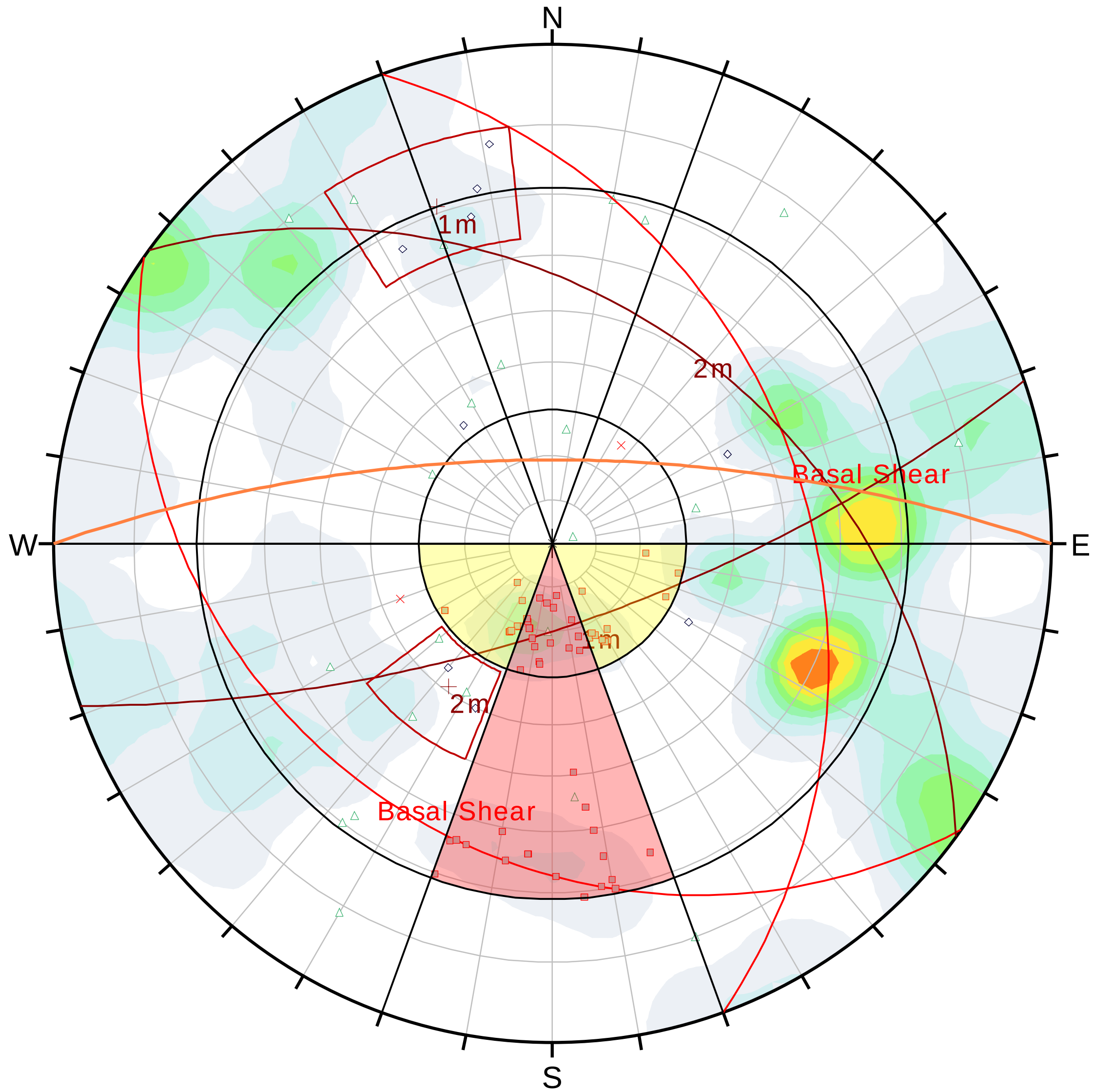
Wedge Sliding: Critical Percentage vs. Slope Dip Direction



Mean Values

Slope Dip = 71   Slope Dip Direction = 0   Friction Angle = 30   Lateral Limit = 20

Terracon	*Project* Oro Grande Amend Reclamation		
	Analysis Description Kinematic Analysis		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sup Macks OGC wedge sens.dips7	*Date* 2/6/2019	



Symbol	TYPE	Quantity
◇	B	10
×	Basal shear	2
△	J	23
Symbol	**Feature**	
▪	Critical Intersection	

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Intersections
Maximum Density	7.18%
Contour Distribution	Fisher
Counting Circle Size	1.0%

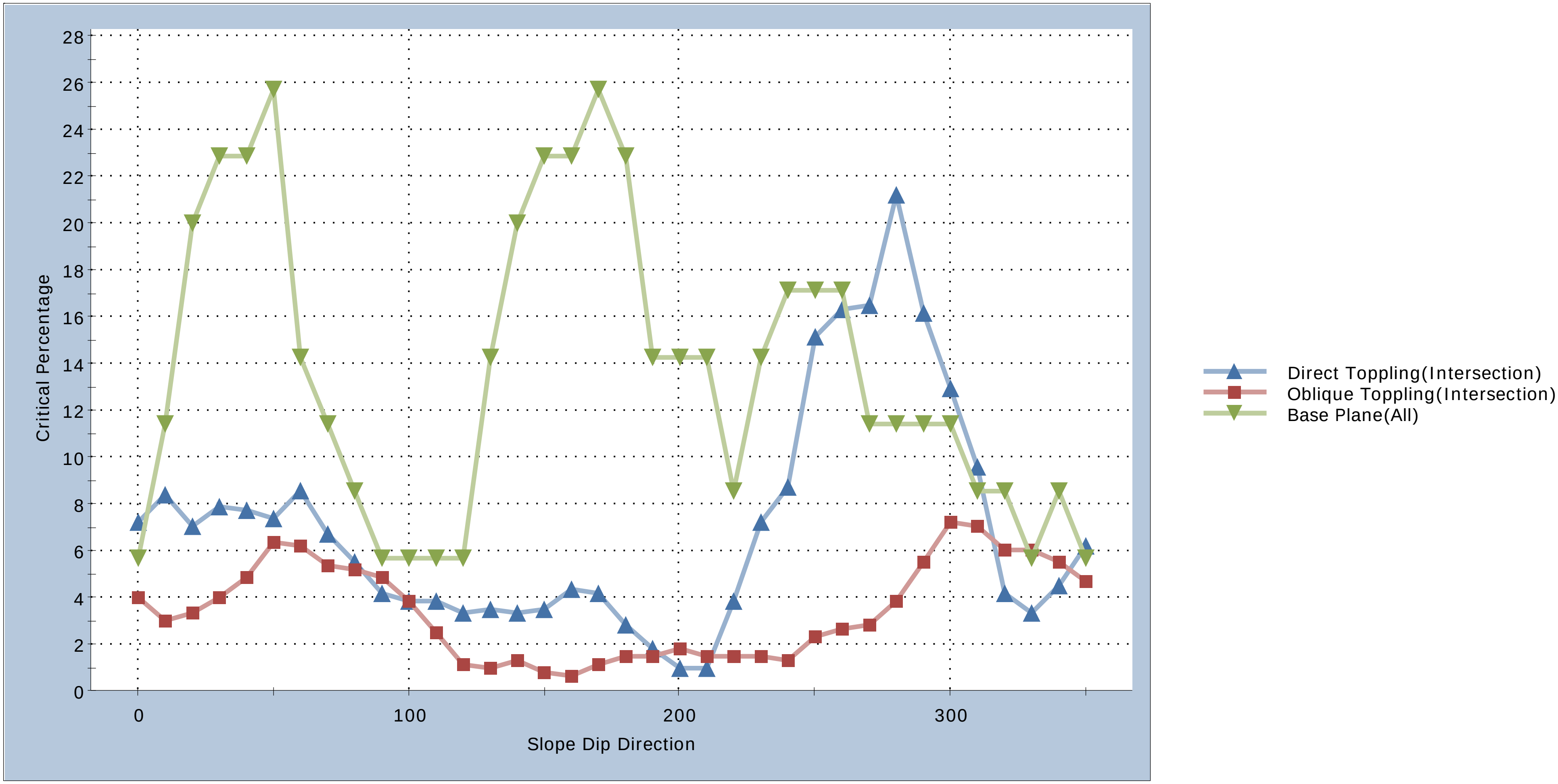
Kinematic Analysis	Direct Toppling
Slope Dip	71
Slope Dip Direction	0
Friction Angle	30°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	43	594	7.24%
Oblique Toppling (Intersection)	24	594	4.04%
Base Plane (All)	2	35	5.71%

Plot Mode	Pole Vectors
Vector Count	35 (35 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	594
Hemisphere	Lower
Projection	Equal Angle

Terracon	*Project* Oro Grande Amend Reclamation		
	Analysis Description Kinematic Analysis		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sup Macks OGC topple.dips7	*Date* 2/6/2019	

Direct Toppling: Critical Percentage vs. Slope Dip Direction



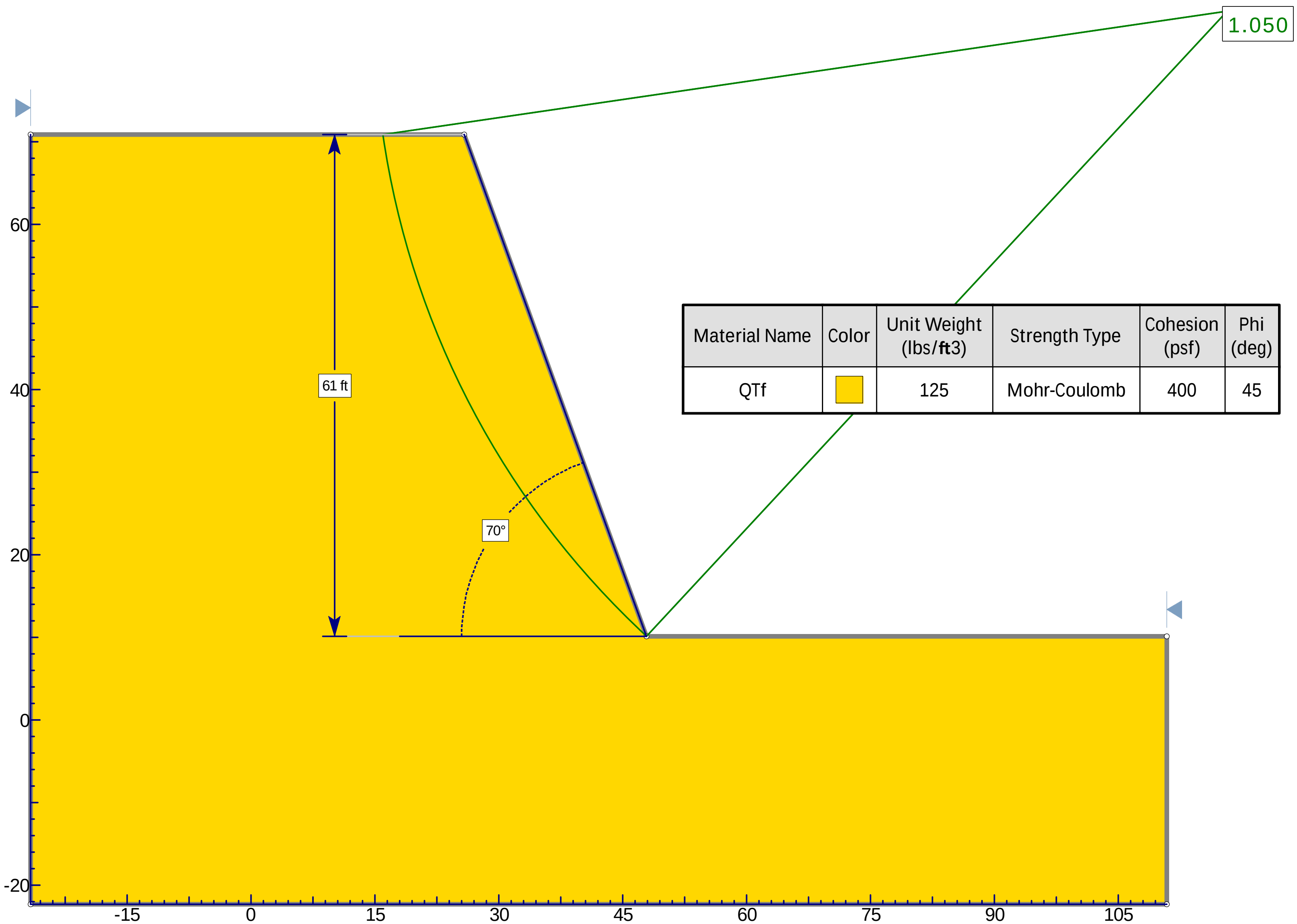
Mean Values

Slope Dip = 71   Slope Dip Direction = 0   Friction Angle = 30   Lateral Limit = 20

Terracon	*Project* Oro Grande Amend Reclamation		
	Analysis Description Kinematic Analysis		
	Drawn By Terracon	*Author* JMc	
DIPS 7.014	*File Name* Sup Macks OGC topple sens.dips7	*Date* 2/6/2019	

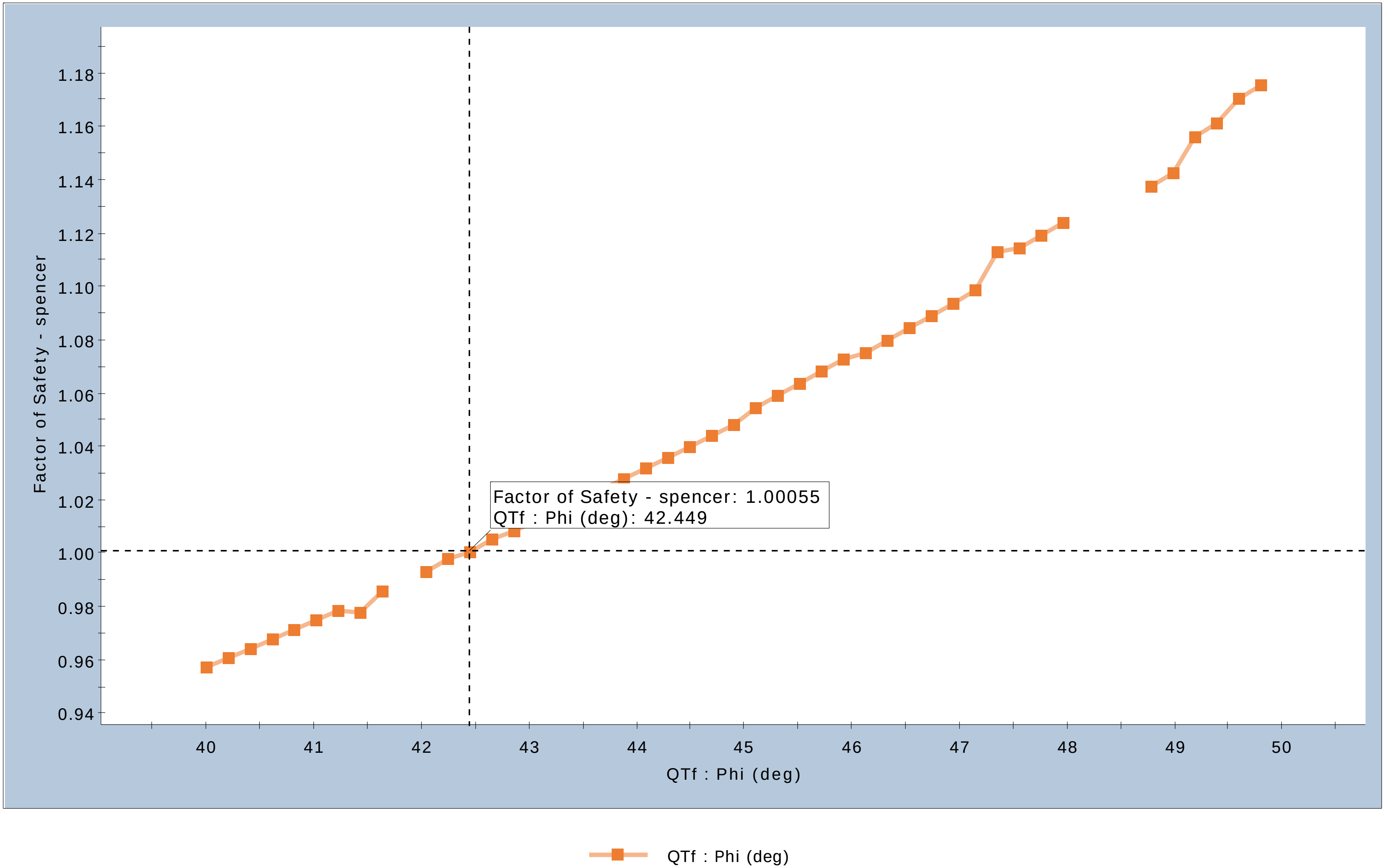
APPENDIX D

GLOBAL STABILITY CALCULATIONS

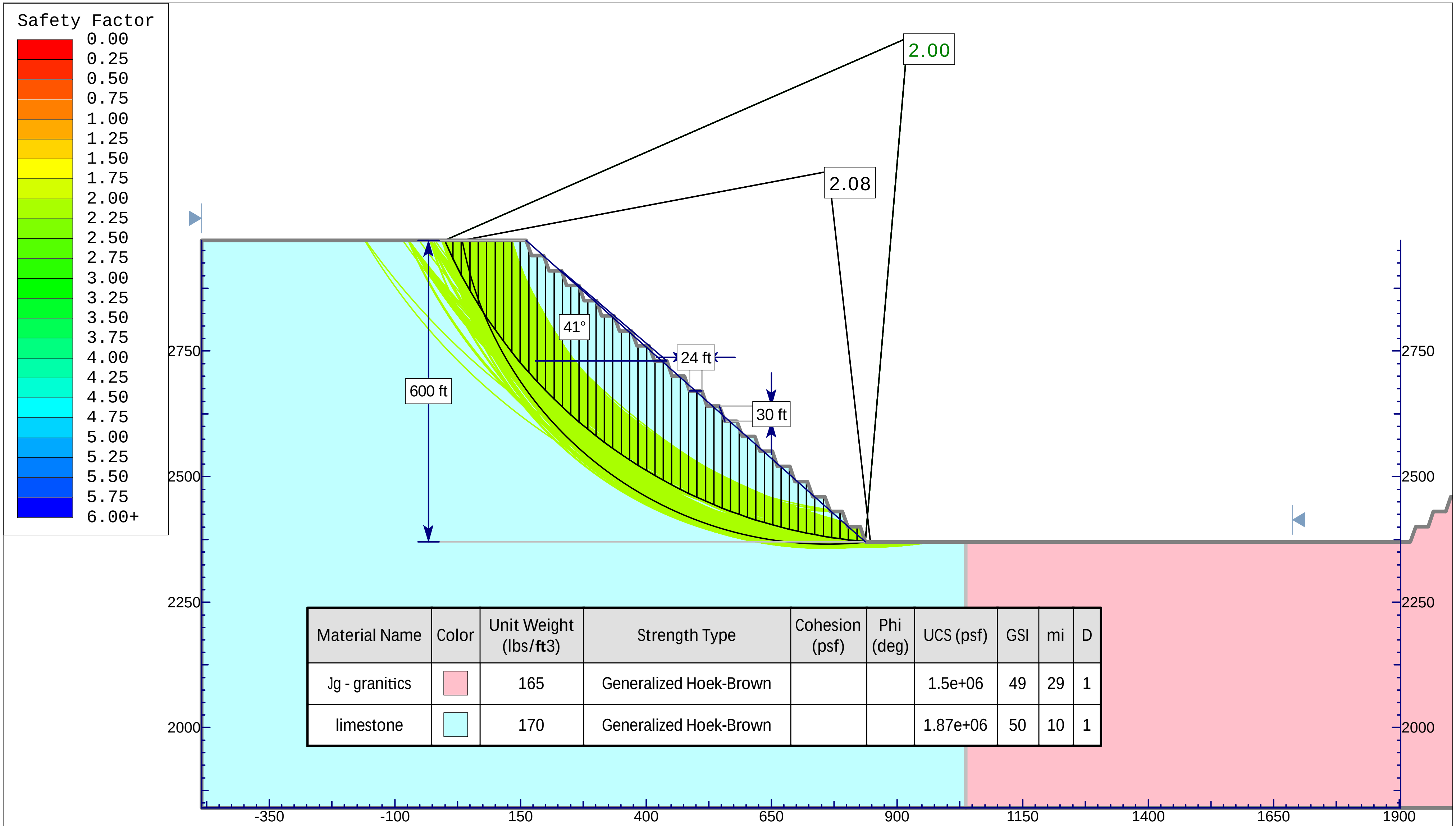


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
QTf		125	Mohr-Coulomb	400	45

Terracon	*Project* CalPortland Oro Grande Amend Rec Plan		
	Analysis Description QTf Back Calculation		
	Drawn By JMc	*Company* Terracon	
SLIDEINTERPRET 8.021	*Date* 1/28/2019, 9:57:15 AM	*File Name* QTf back calc.slmd	



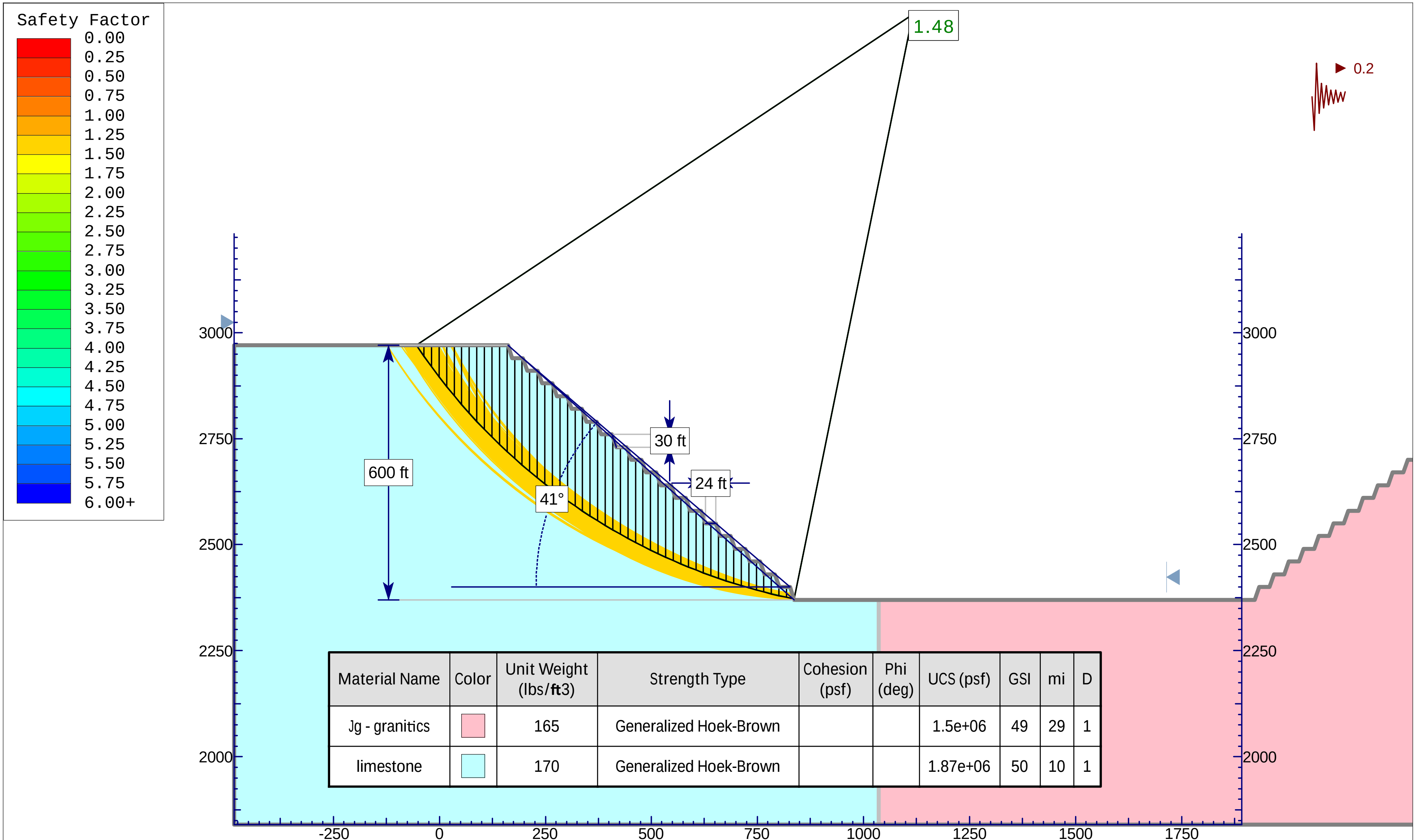
Terracon	*Project* CalPortland Oro Grande Amend Rec Plan		
	Analysis Description QTf Back Calculation		
	Drawn By JMc	*Company* Terracon	
SLIDEINTERPRET 8.021	*Date* 1/28/2019, 9:57:15 AM	*File Name* QTf back calc.slmd	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Jg - granitics		165	Generalized Hoek-Brown			1.5e+06	49	29	1
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section F - Limestone Wall		
Drawn By	JMc	*Company*	Terracon
Date		*File Name*	Section F ls wall revised geom.slmd

SLIDEINTERPRET 8.021

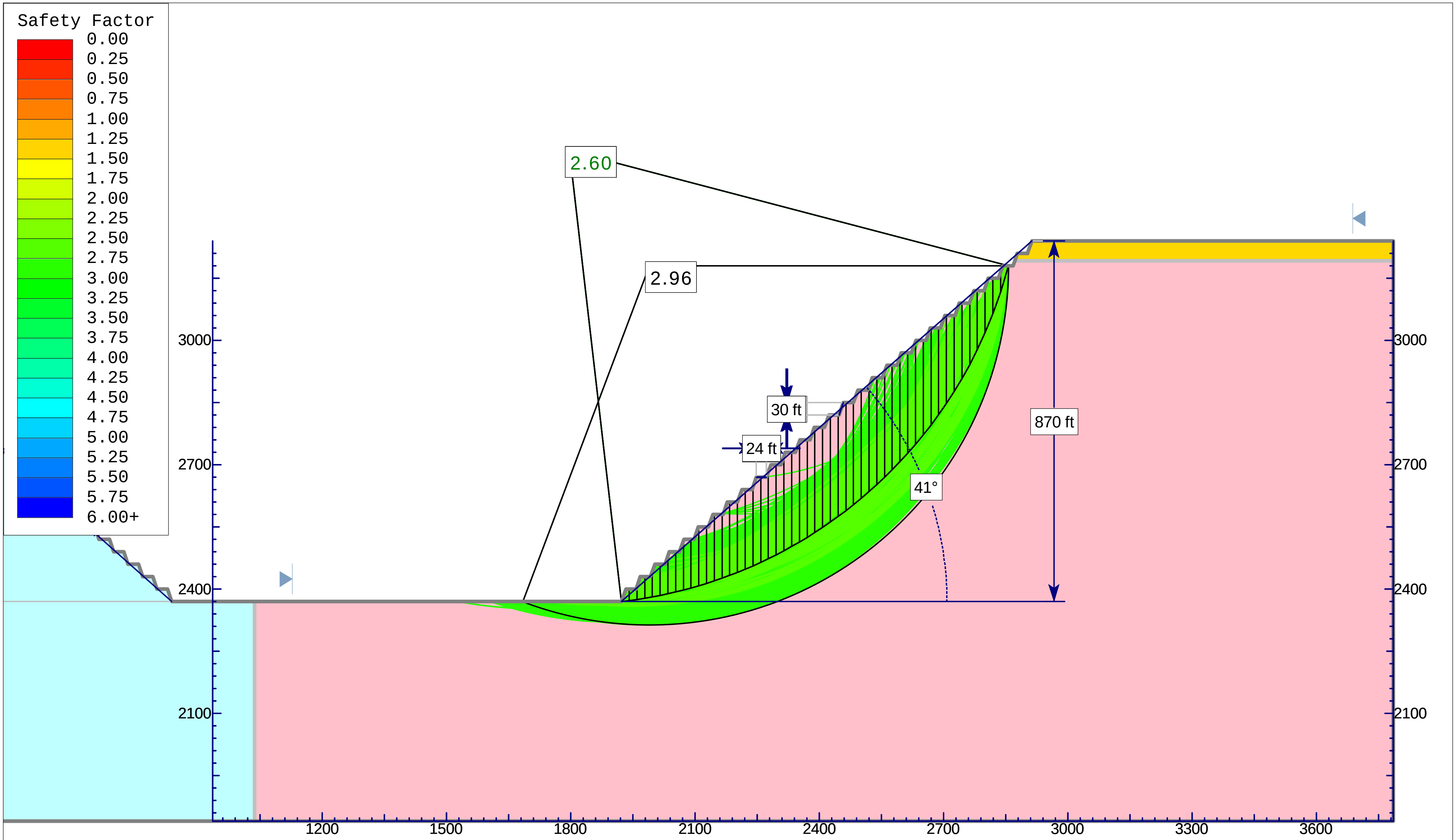


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Jg - granitics		165	Generalized Hoek-Brown			1.5e+06	49	29	1
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1

Terracon

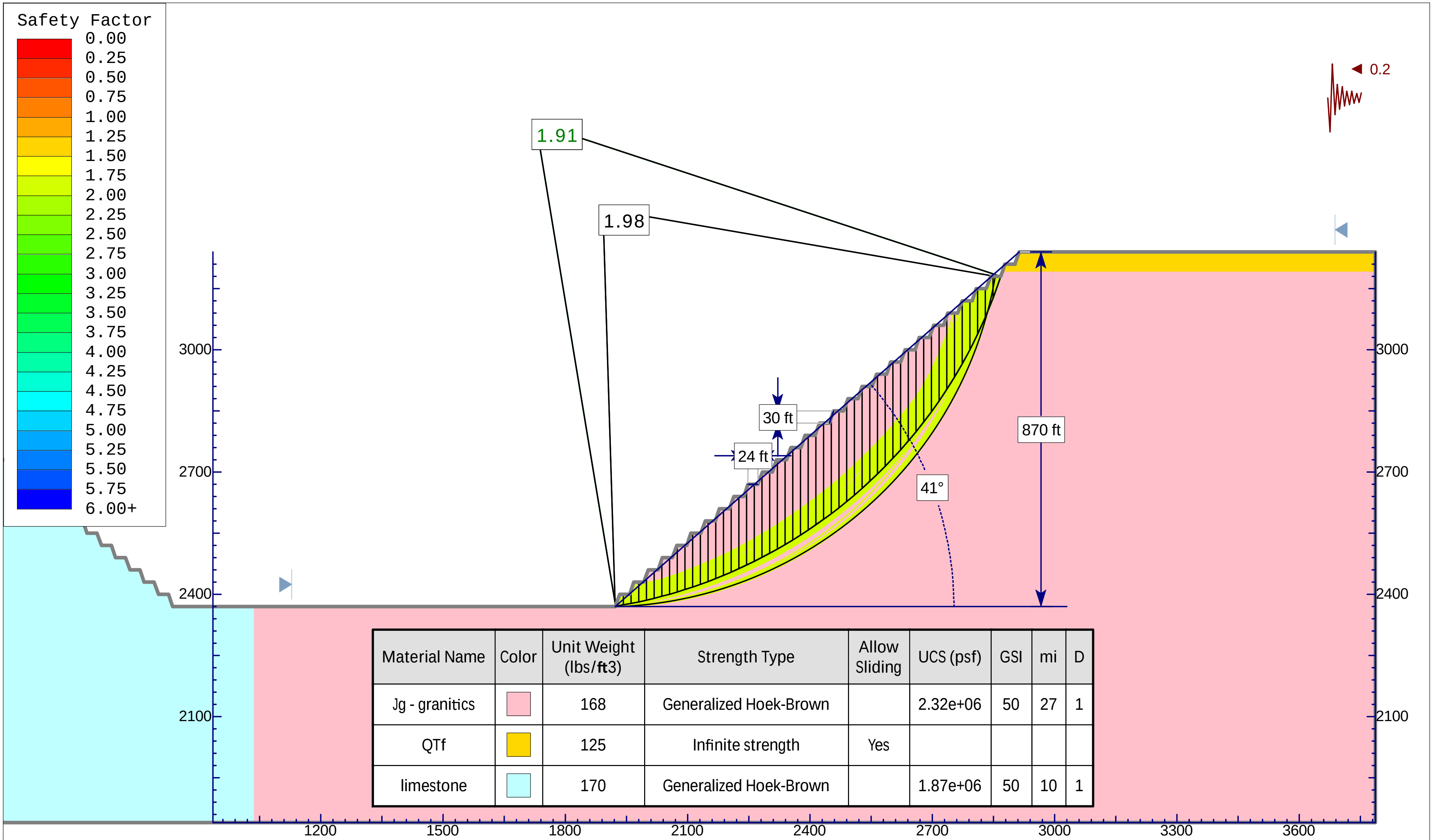
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section F - Limestone Wall
Drawn By	JMc
Company	Terracon
Date	
File Name	Section F ls wall revised geom.slmd



Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section F - Granitics Wall
Drawn By JMc	*Company* Terracon
Date	*File Name* Section F Jg wall revised geom.slmd

SLIDEINTERPRET 8.021



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Allow Sliding	UCS (psf)	GSI	mi	D
Jg - granitics		168	Generalized Hoek-Brown		2.32e+06	50	27	1
QTf		125	Infinite strength	Yes				
limestone		170	Generalized Hoek-Brown		1.87e+06	50	10	1

Terracon

SLIDEINTERPRET 8.021

Project
CalPortland Oro Grande Amend Rec Plan

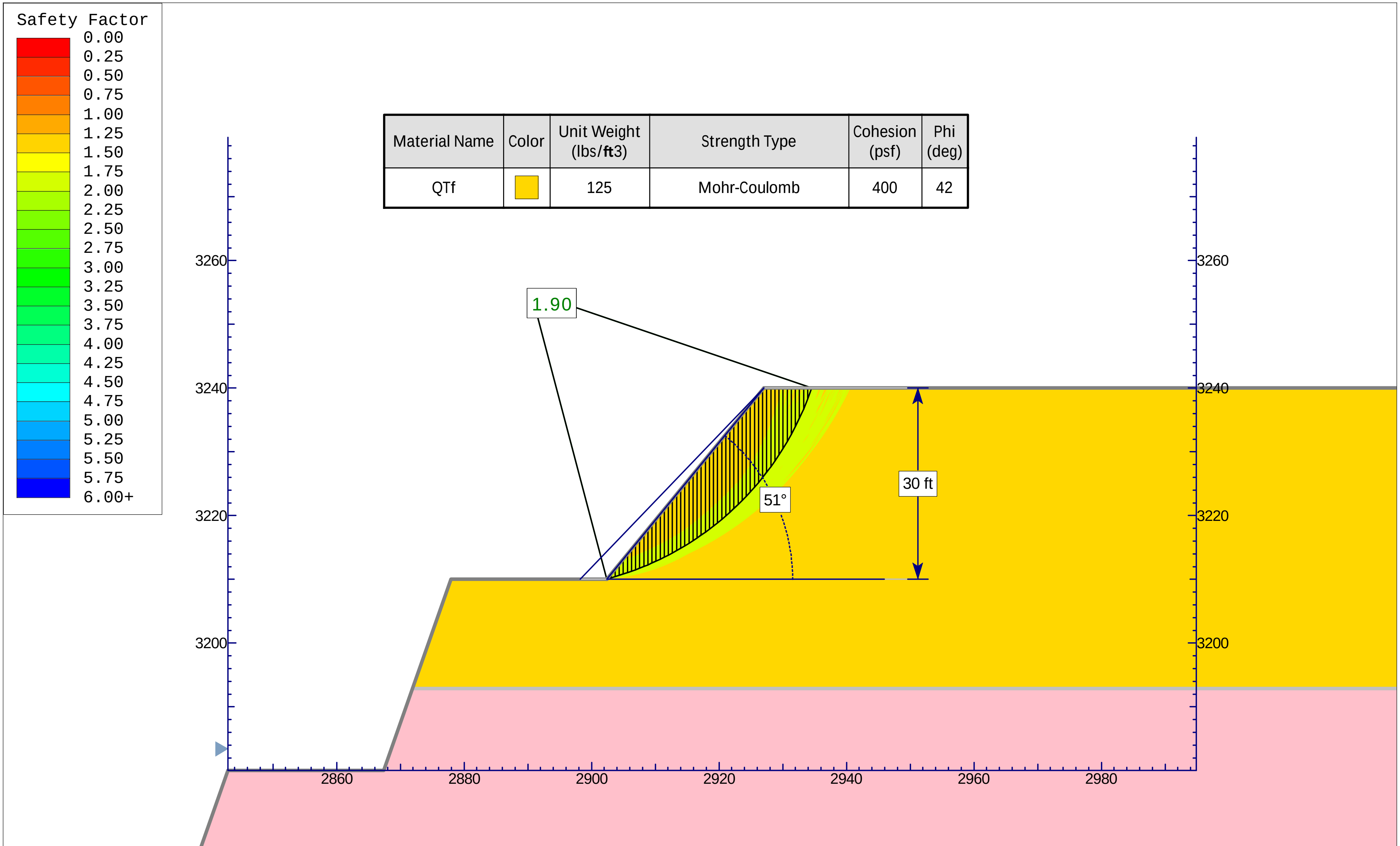
Analysis Description
Section F - Granitics Wall

Drawn By
JMc

Company
Terracon

Date

File Name
Section F Jg wall revised geom.slmd

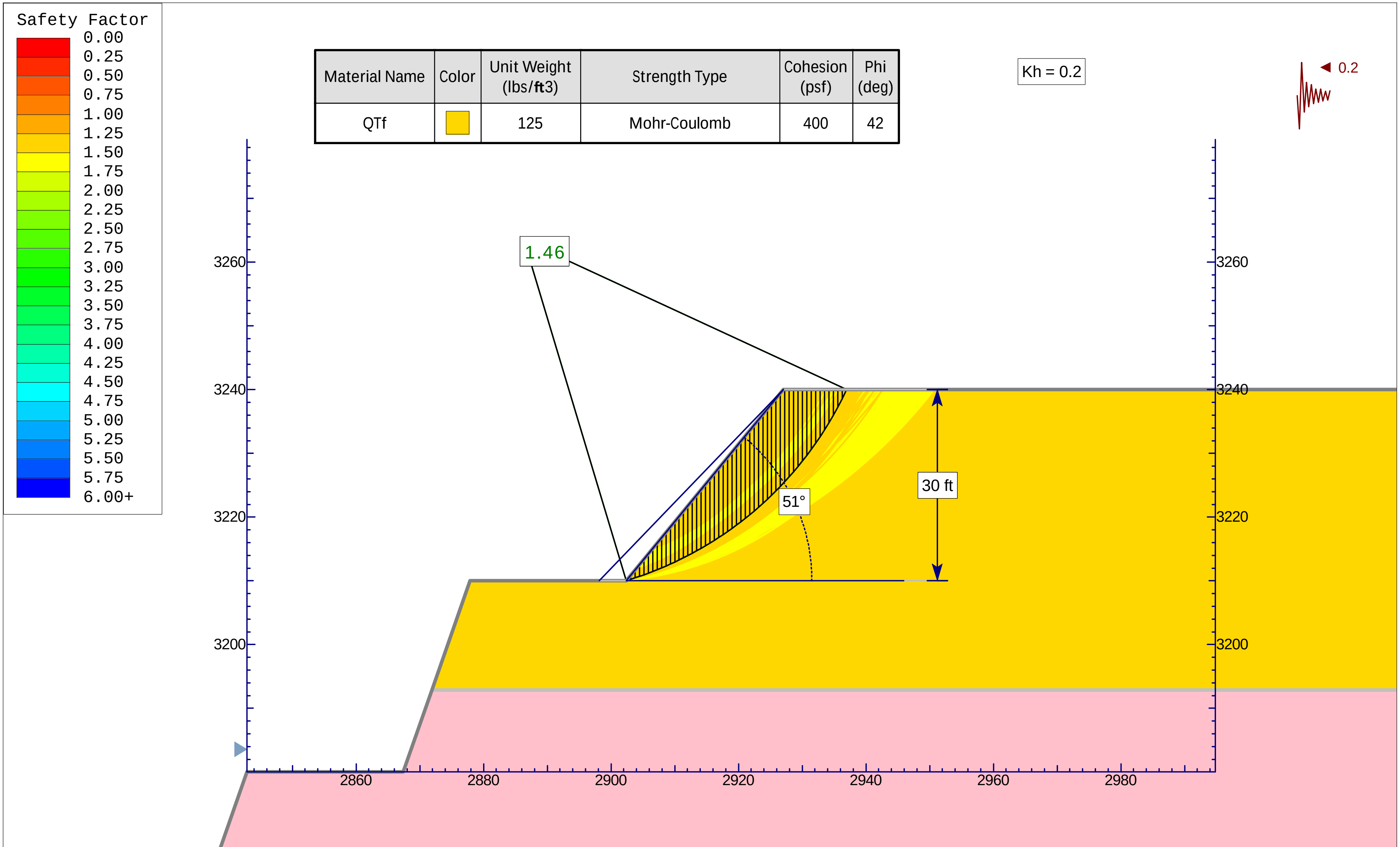


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
QTf		125	Mohr-Coulomb	400	42

Terracon

SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section F - QTf
Drawn By	JMc
Company	Terracon
Date	
File Name	Section F QTf wall revised geom.slmd

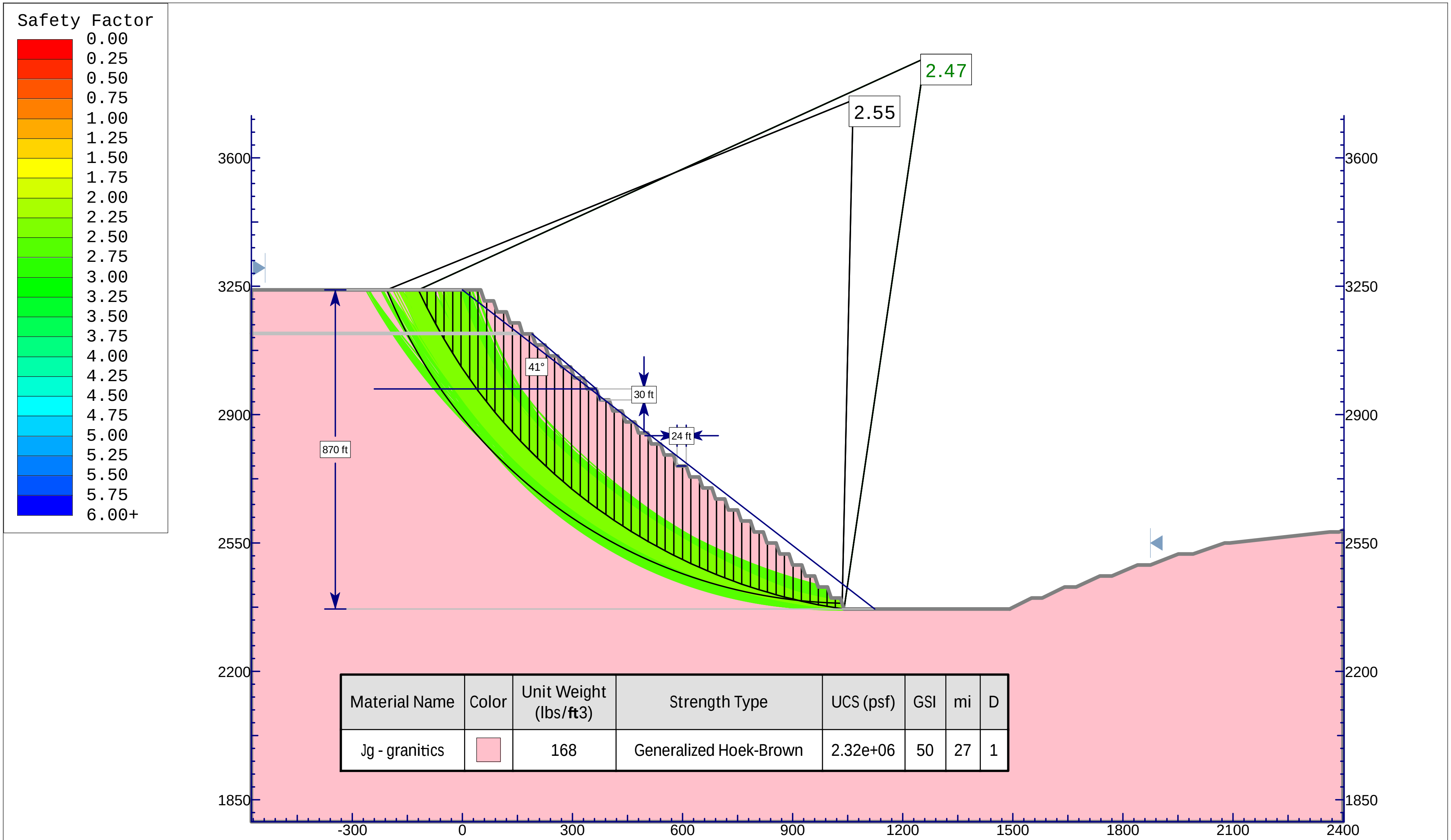


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
QTf		125	Mohr-Coulomb	400	42

Terracon

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section F - QTf		
Drawn By	JMc	*Company*	Terracon
Date		*File Name*	Section F QTf wall revised geom.slmd

SLIDEINTERPRET 8.021

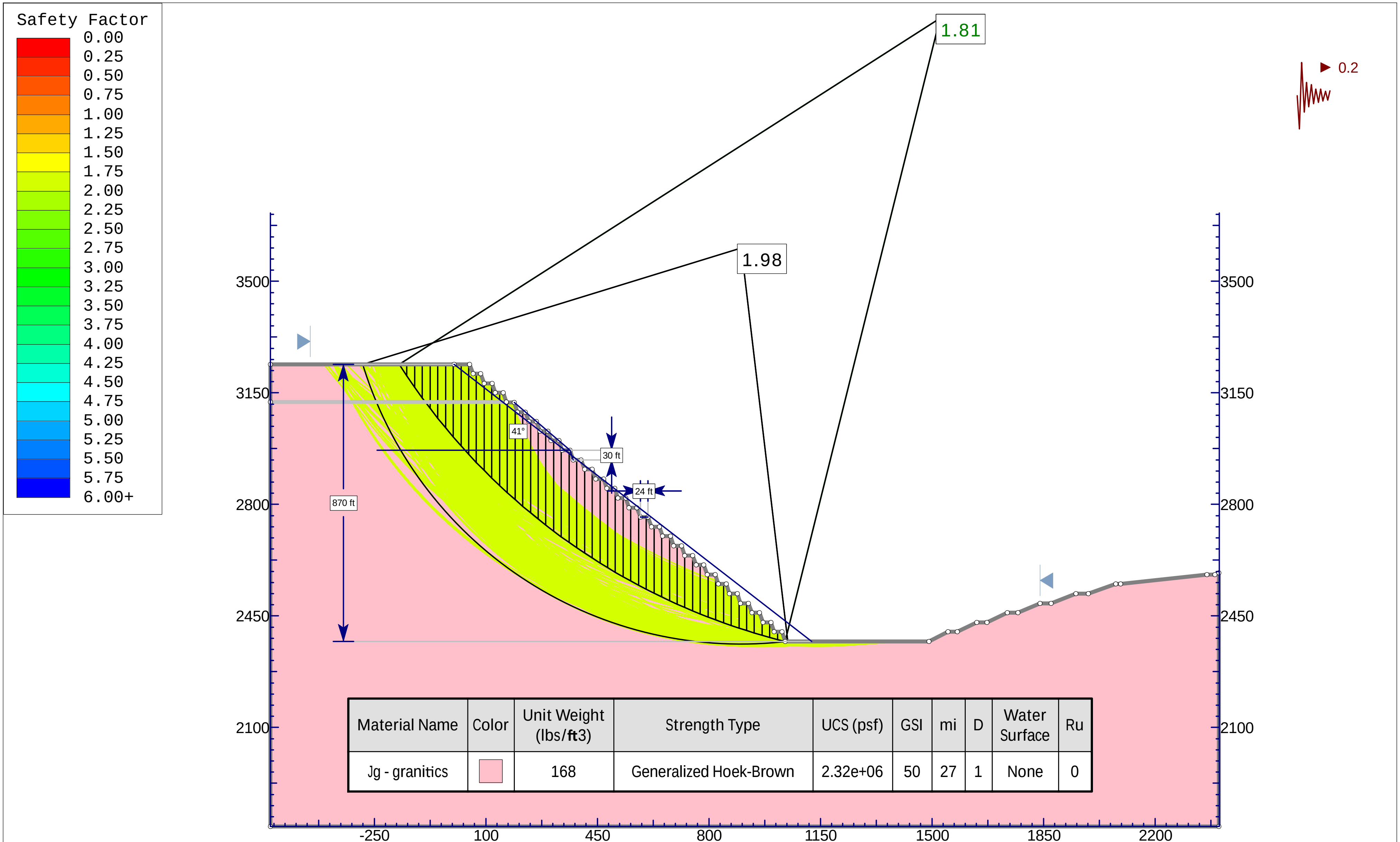


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (psf)	GSI	mi	D
Jg - granitics		168	Generalized Hoek-Brown	2.32e+06	50	27	1

Terracon

SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section G
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 9:55:37 AM
File Name	section G revised geometry.slmd

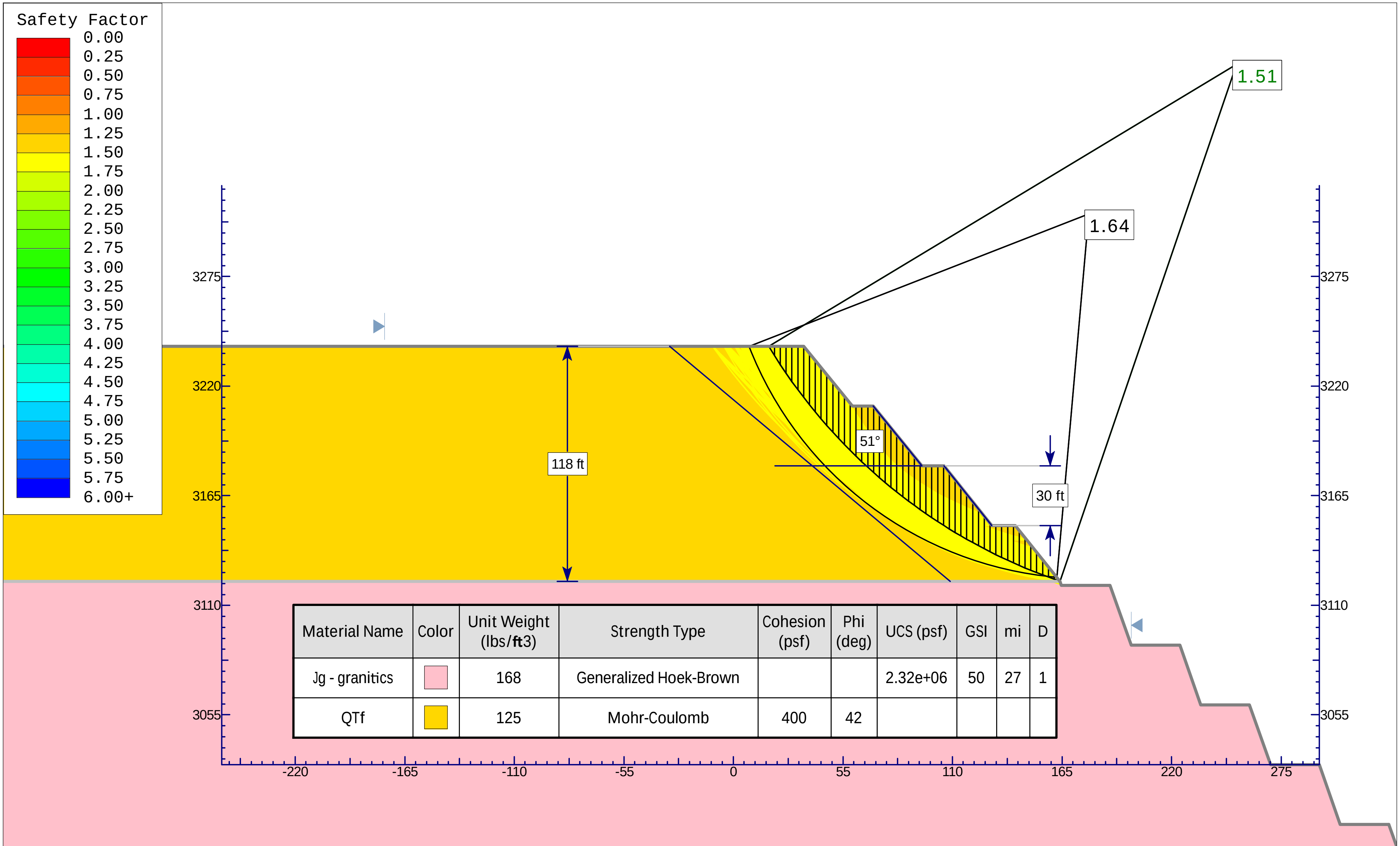


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (psf)	GSI	mi	D	Water Surface	Ru
Jg - granitics		168	Generalized Hoek-Brown	2.32e+06	50	27	1	None	0

Terracon

SLIDEINTERPRET 8.021

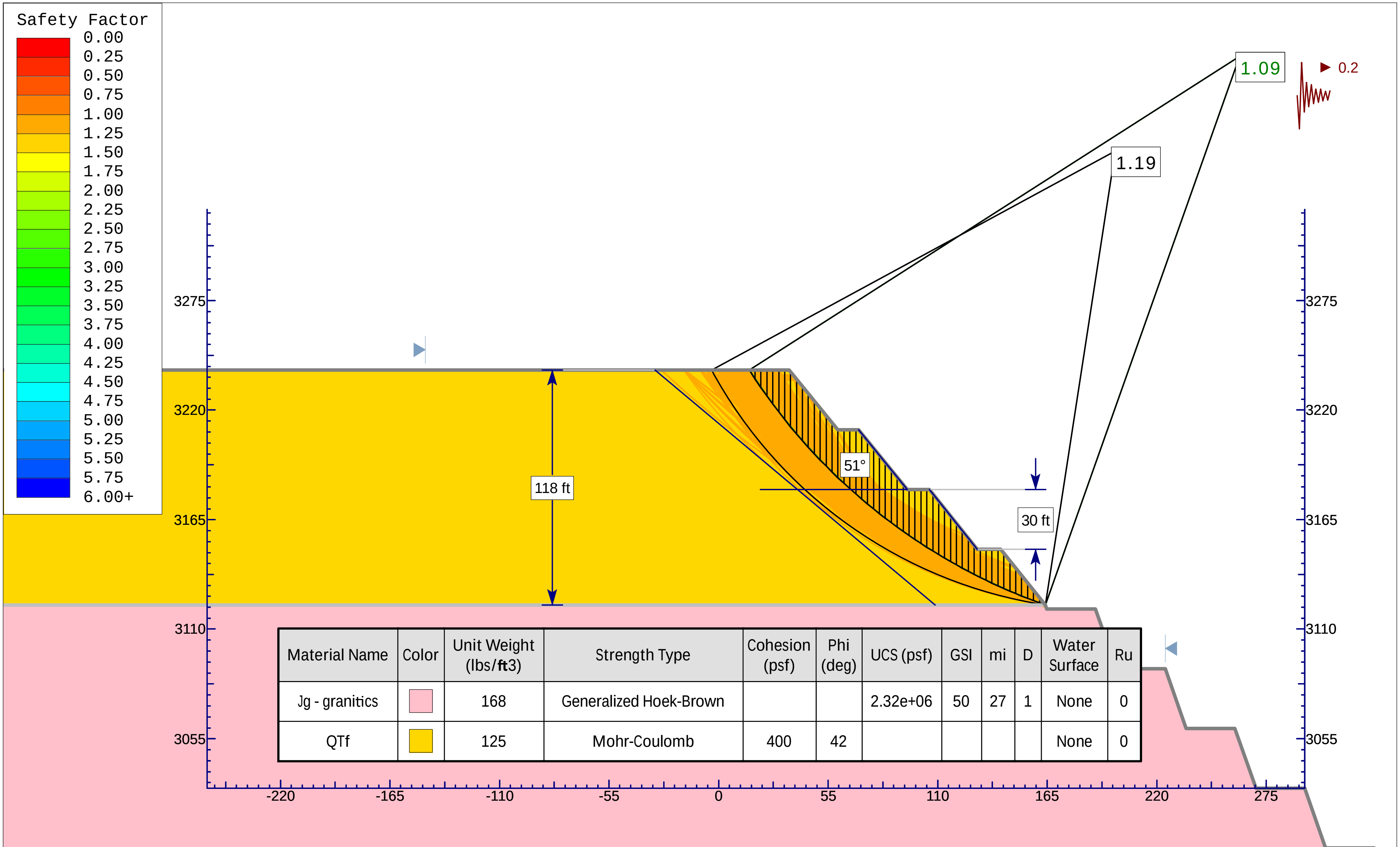
Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section G
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 9:55:37 AM
File Name	section G revised geometry.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Jg - granitics		168	Generalized Hoek-Brown			2.32e+06	50	27	1
QTf		125	Mohr-Coulomb	400	42				

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section G - QTf
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 9:55:37 AM
File Name	section G QTF portion revised geometry.slmd

SLIDEINTERPRET 8.021

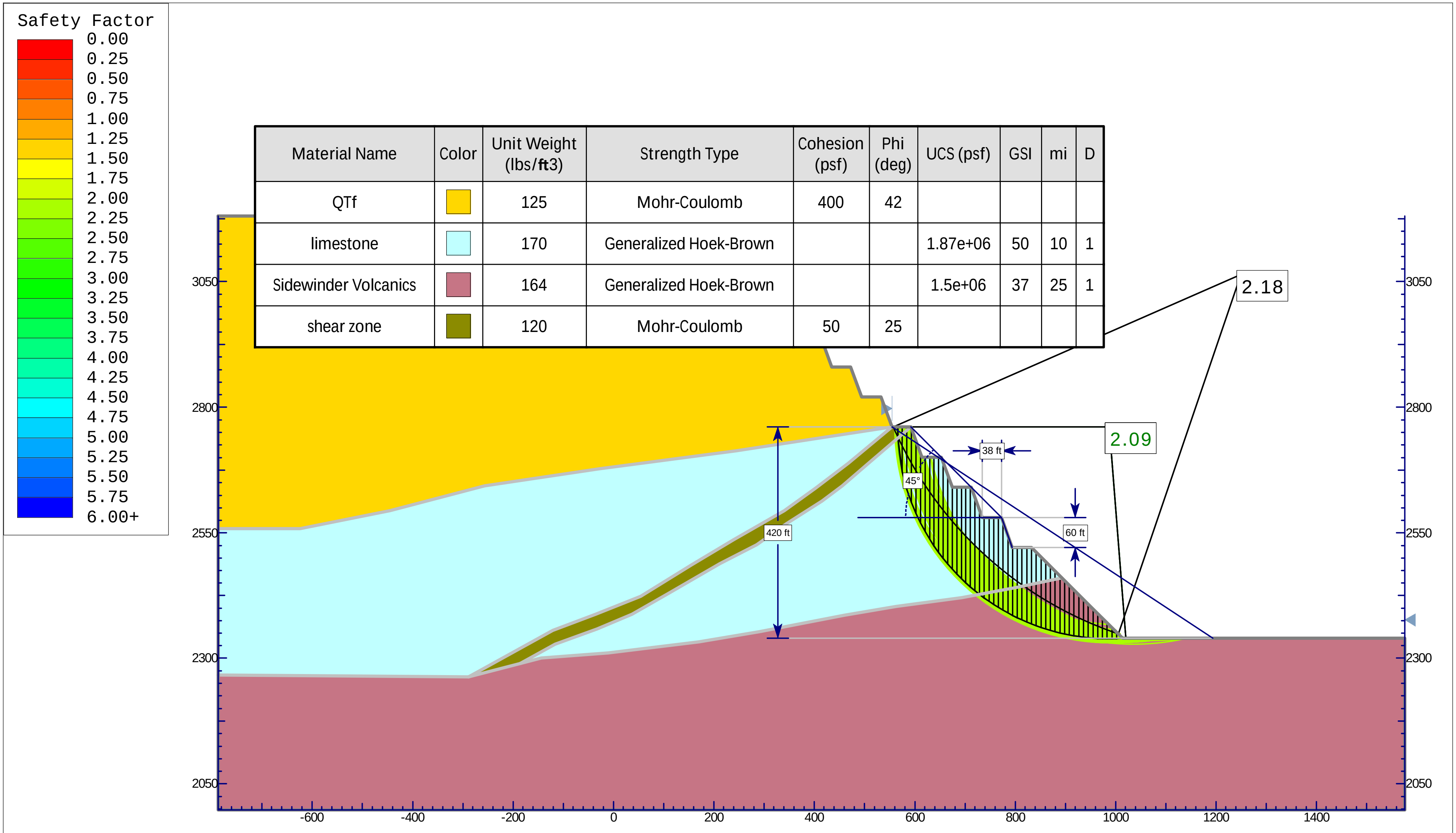


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface	Ru
Jg - granitics		168	Generalized Hoek-Brown			2.32e+06	50	27	1	None	0
QTf		125	Mohr-Coulomb	400	42					None	0

Terracon

SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section G - QTf
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 9:55:37 AM
File Name	section G QTF portion revised geometry.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
QTf		125	Mohr-Coulomb	400	42				
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1
shear zone		120	Mohr-Coulomb	50	25				

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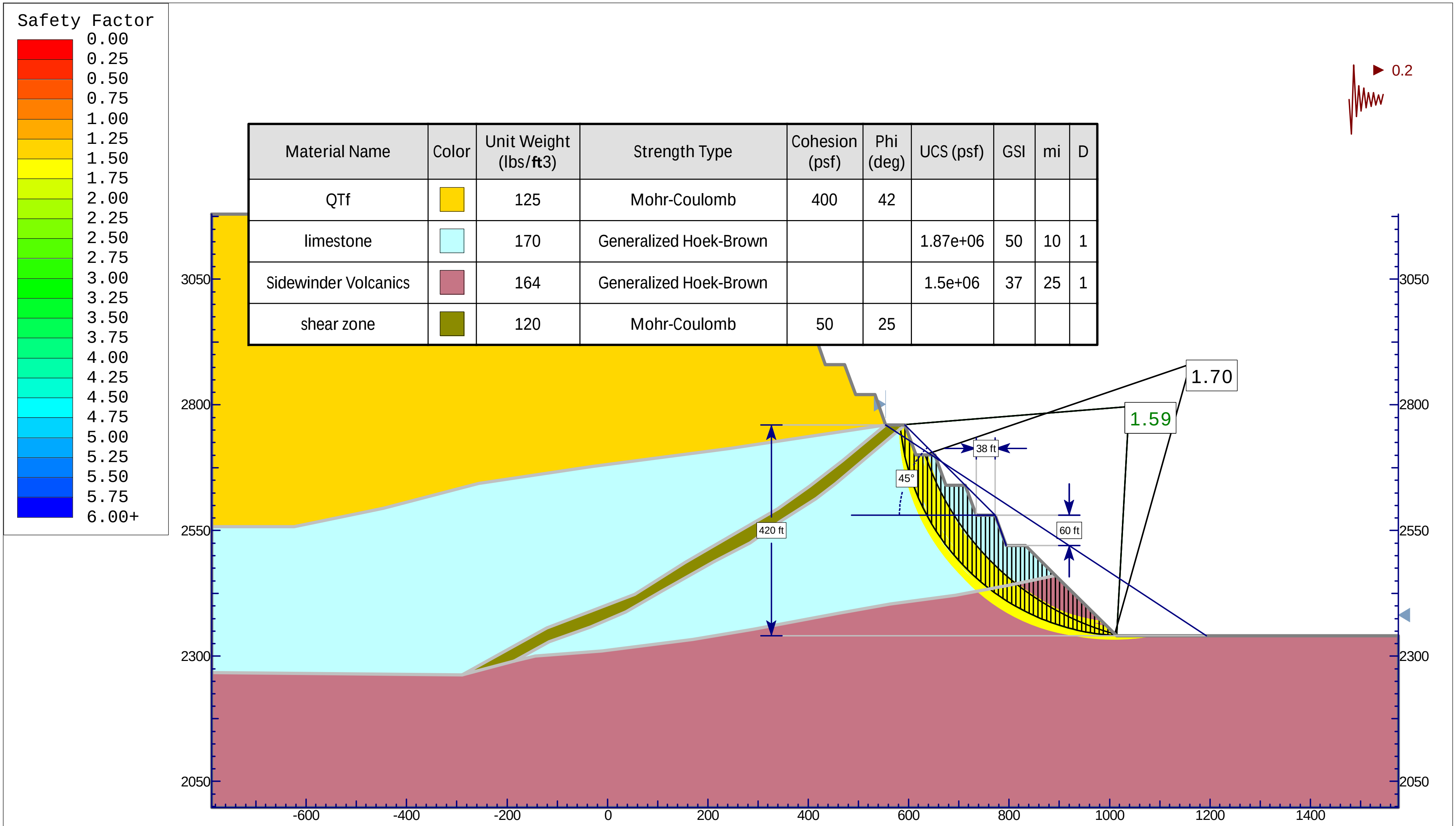
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section H - LS & Js Portion		
Drawn By	JMc	*Company*	Terracon
Date	1/28/2019, 9:57:15 AM	*File Name*	section H.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
QTf		125	Mohr-Coulomb	400	42				
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1
shear zone		120	Mohr-Coulomb	50	25				

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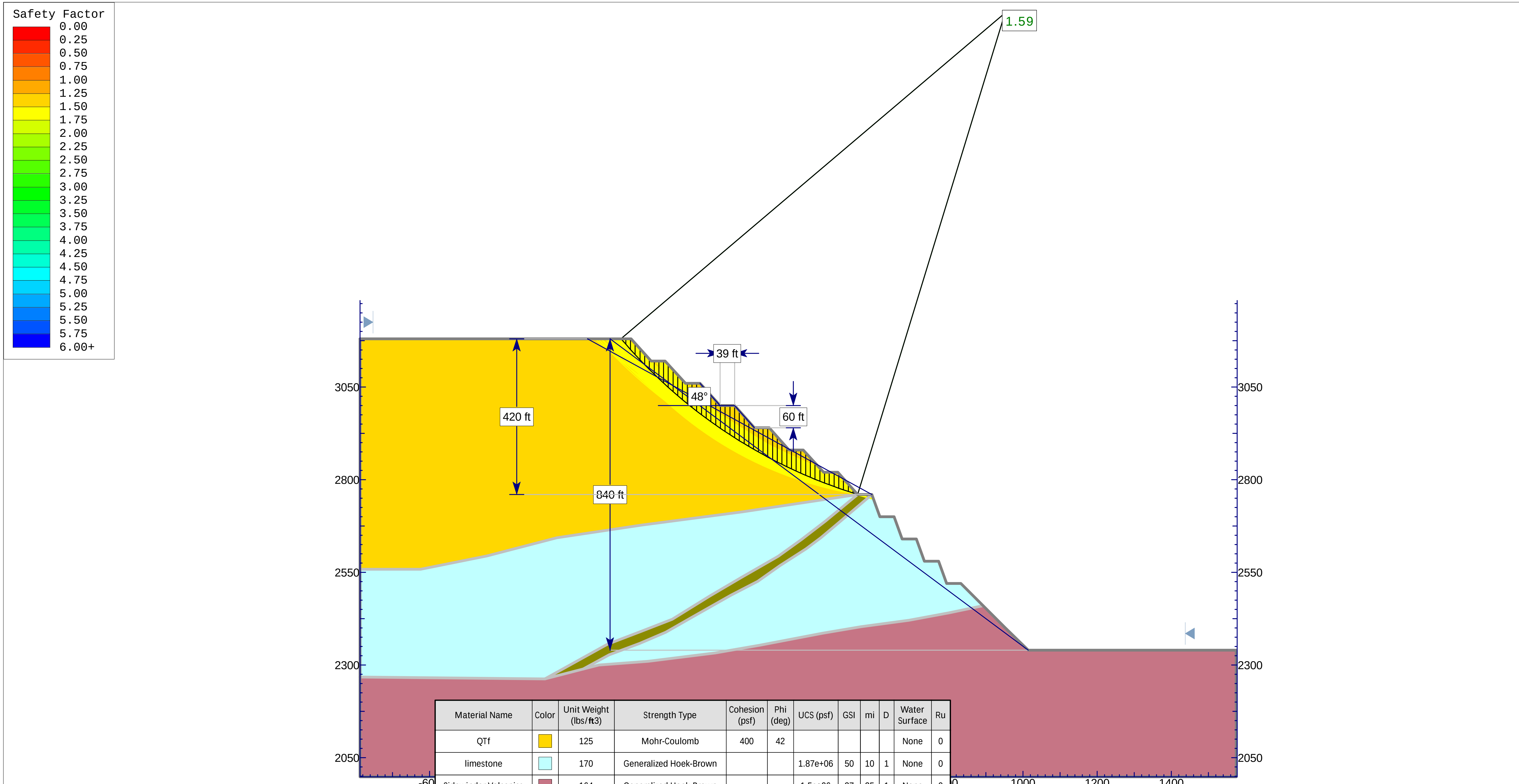
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section H - LS & Js Portion		
Drawn By	JMc	*Company*	Terracon
Date	1/28/2019, 9:57:15 AM	*File Name*	section H.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface	Ru
QTf		125	Mohr-Coulomb	400	42					None	0
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1	None	0
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1	None	0
shear zone		120	Mohr-Coulomb	50	25					None	0

SLIDEINTERPRET 8.021

Project
CalPortland Oro Grande Amend Rec Plan

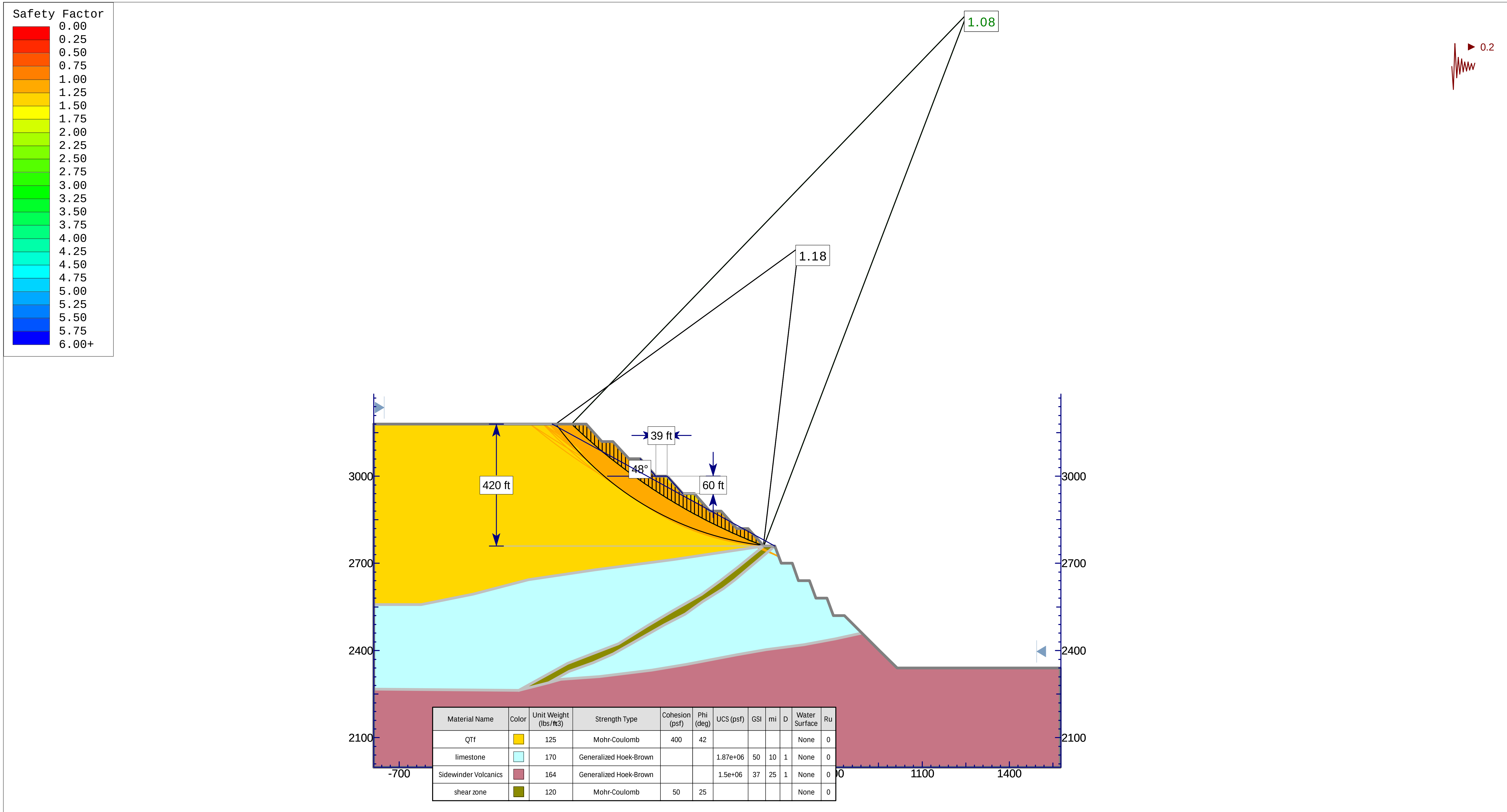
Analysis Description
Section H - QTf mod whole slope

Drawn By JMc

Company Terracon

Date 1/28/2019, 9:57:15 AM

File Name section H mod 48d faces.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface	Ru
QTf		125	Mohr-Coulomb	400	42					None	0
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1	None	0
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1	None	0
shear zone		120	Mohr-Coulomb	50	25					None	0

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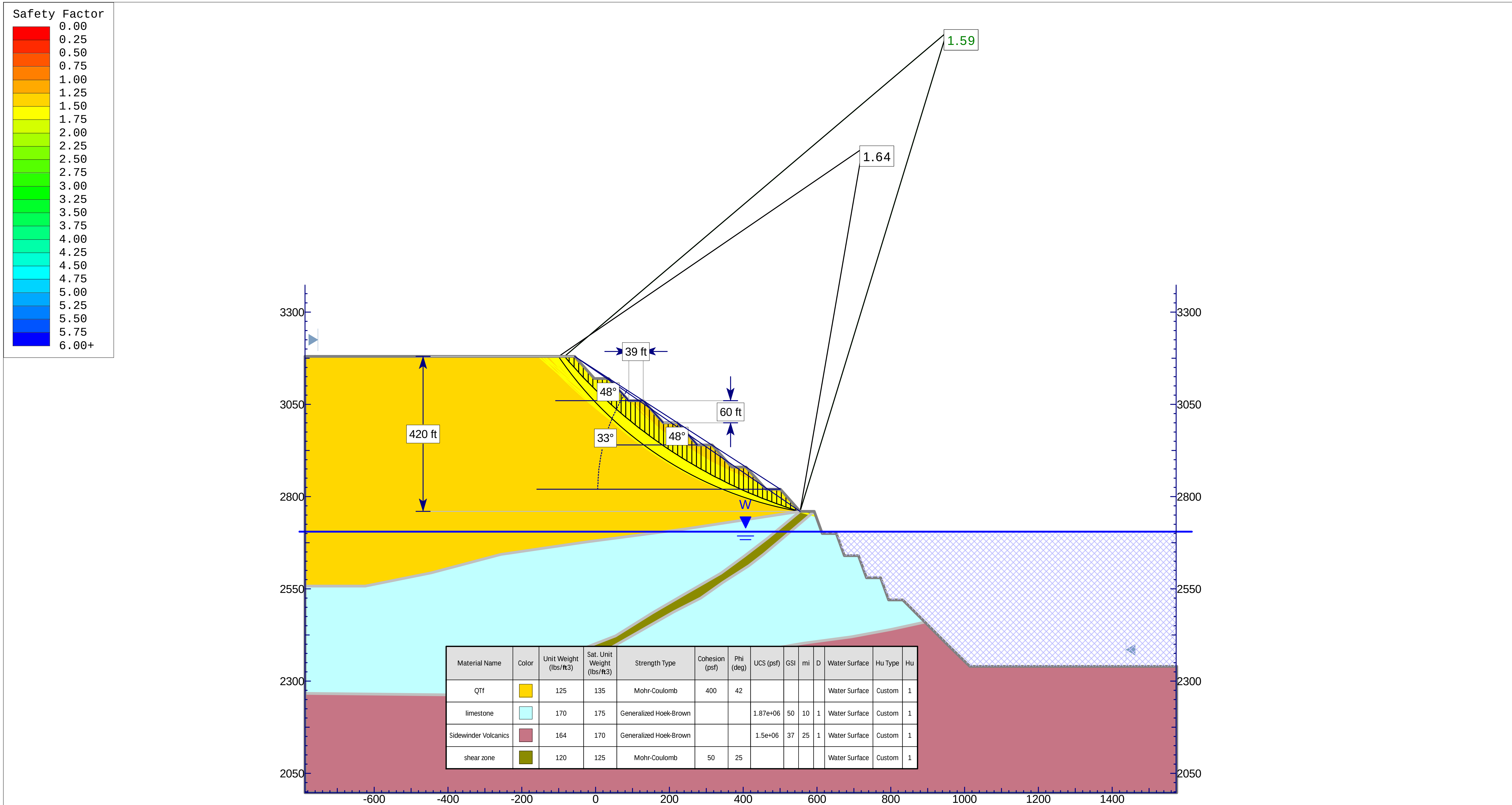
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section H - QTf mod whole slope
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 9:57:15 AM
File Name	section H mod 48d faces.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface	Hu Type	Hu
QTf		125	135	Mohr-Coulomb	400	42					Water Surface	Custom	1
limestone		170	175	Generalized Hoek-Brown			1.87e+06	50	10	1	Water Surface	Custom	1
Sidewinder Volcanics		164	170	Generalized Hoek-Brown			1.5e+06	37	25	1	Water Surface	Custom	1
shear zone		120	125	Mohr-Coulomb	50	25					Water Surface	Custom	1

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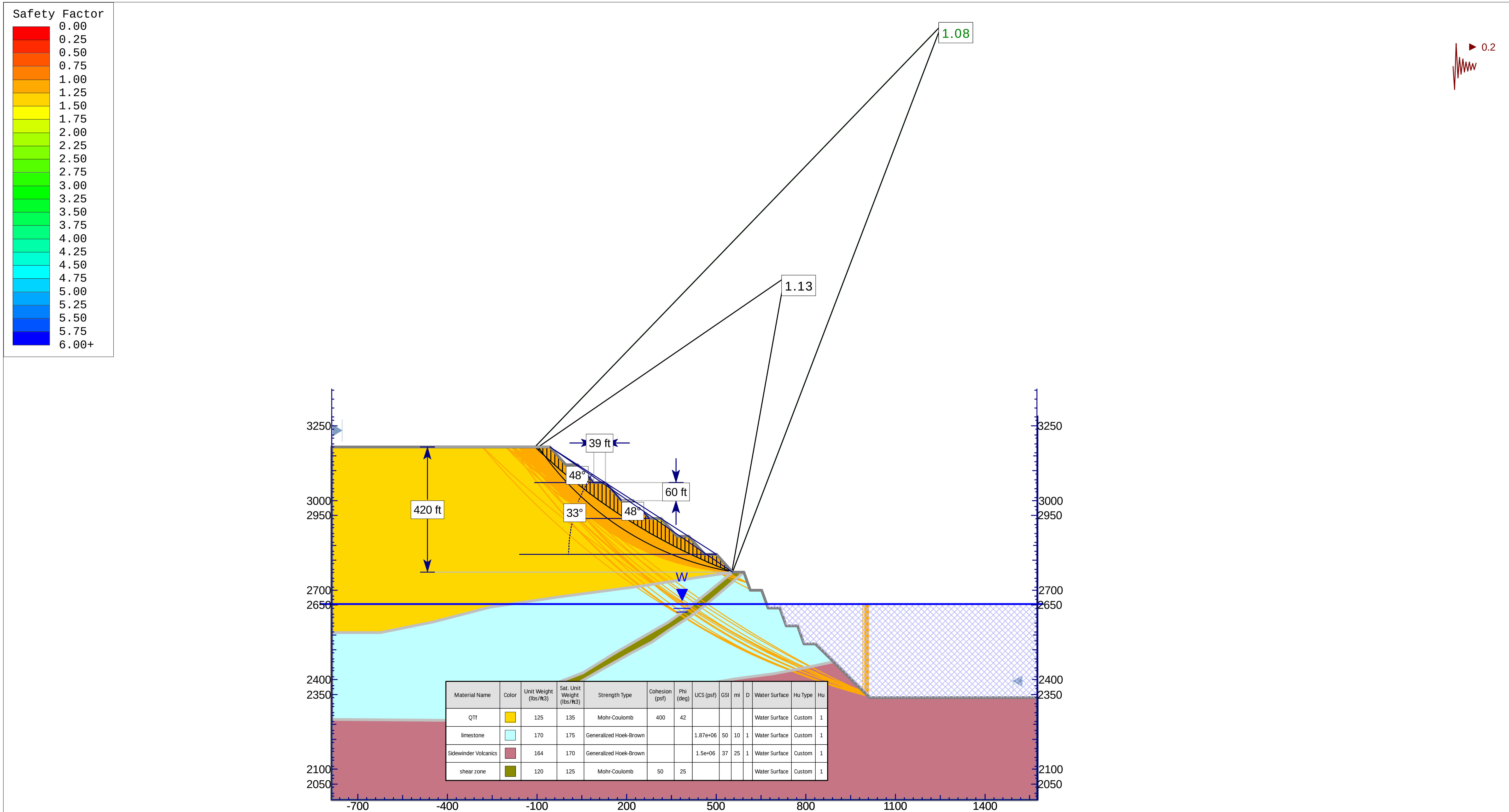
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section H - QTf mod whole slope w/ water table		
Drawn By	JMc	*Company*	Terracon
Date	1/28/2019, 9:57:15 AM	*File Name*	section H mod 48d faces water table.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface	Hu Type	Hu
QTf		125	135	Mohr-Coulomb	400	42					Water Surface	Custom	1
limestone		170	175	Generalized Hoek-Brown			1.87e+06	50	10	1	Water Surface	Custom	1
Sidewinder Volcanics		164	170	Generalized Hoek-Brown			1.5e+06	37	25	1	Water Surface	Custom	1
shear zone		120	125	Mohr-Coulomb	50	25					Water Surface	Custom	1

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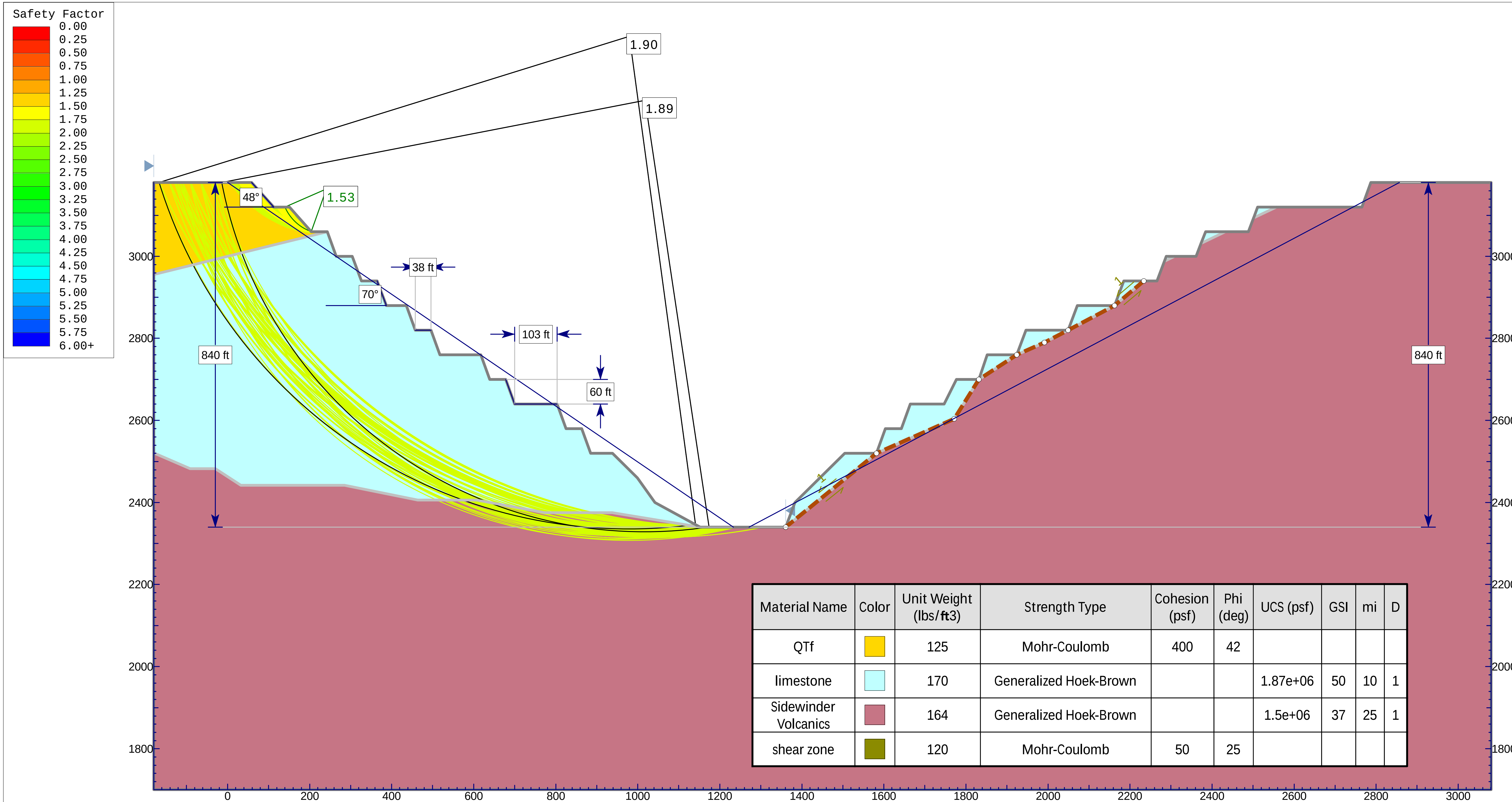
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section H - QTf mod whole slope w/ water table		
Drawn By	JMc	*Company*	Terracon
Date	1/28/2019, 9:57:15 AM	*File Name*	section H mod 48d faces water table.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
QTf		125	Mohr-Coulomb	400	42				
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1
shear zone		120	Mohr-Coulomb	50	25				

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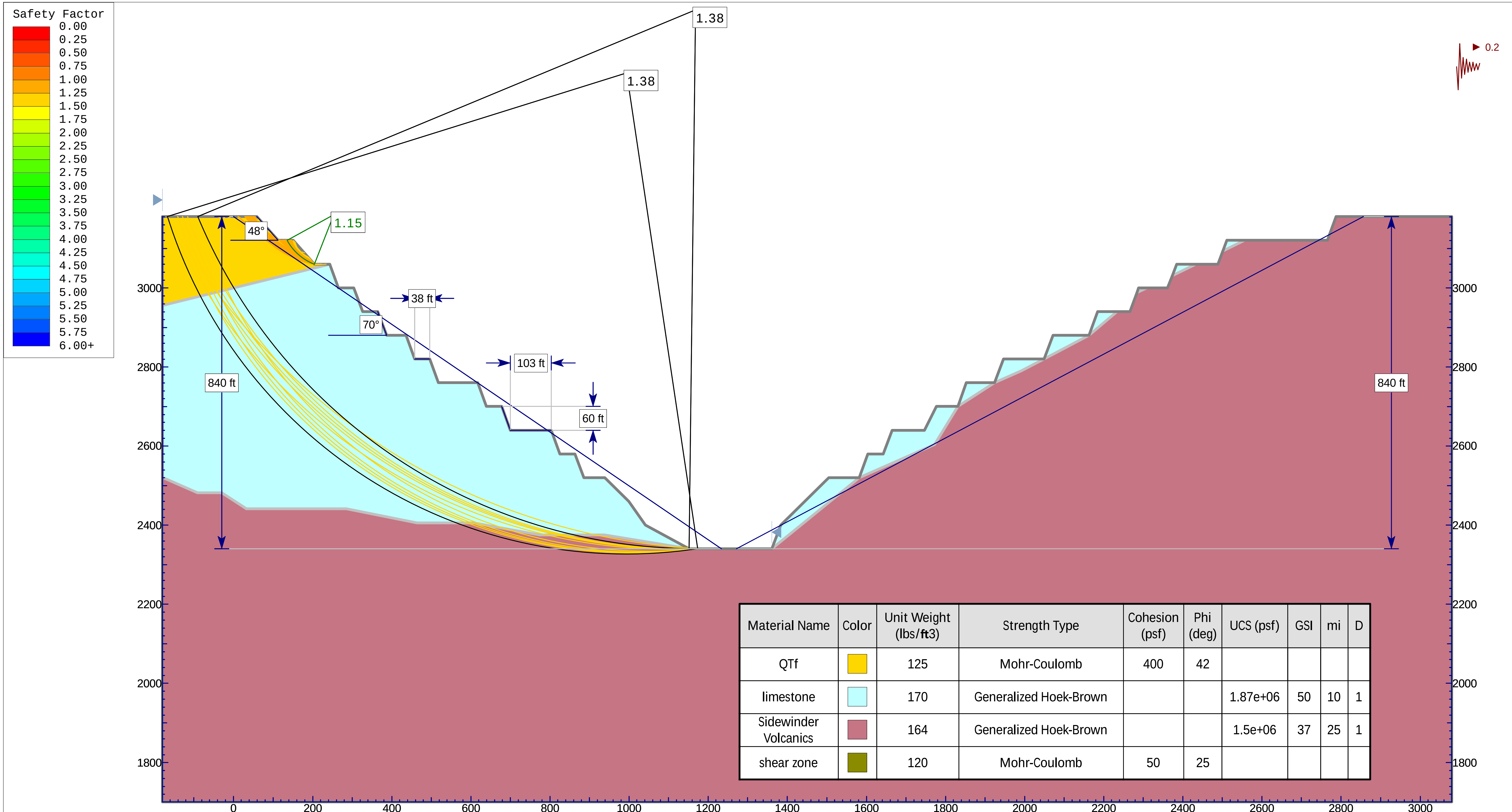
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section I - QTf mod whole slope
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 10:03:20 AM
File Name	section I.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
QTf		125	Mohr-Coulomb	400	42				
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1
shear zone		120	Mohr-Coulomb	50	25				

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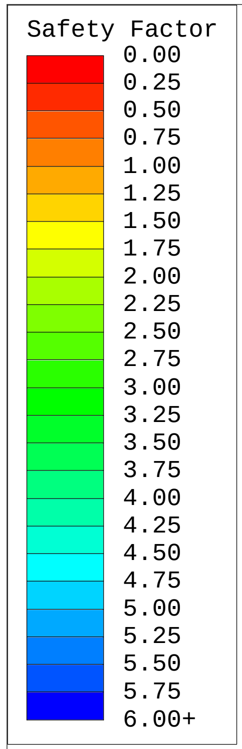
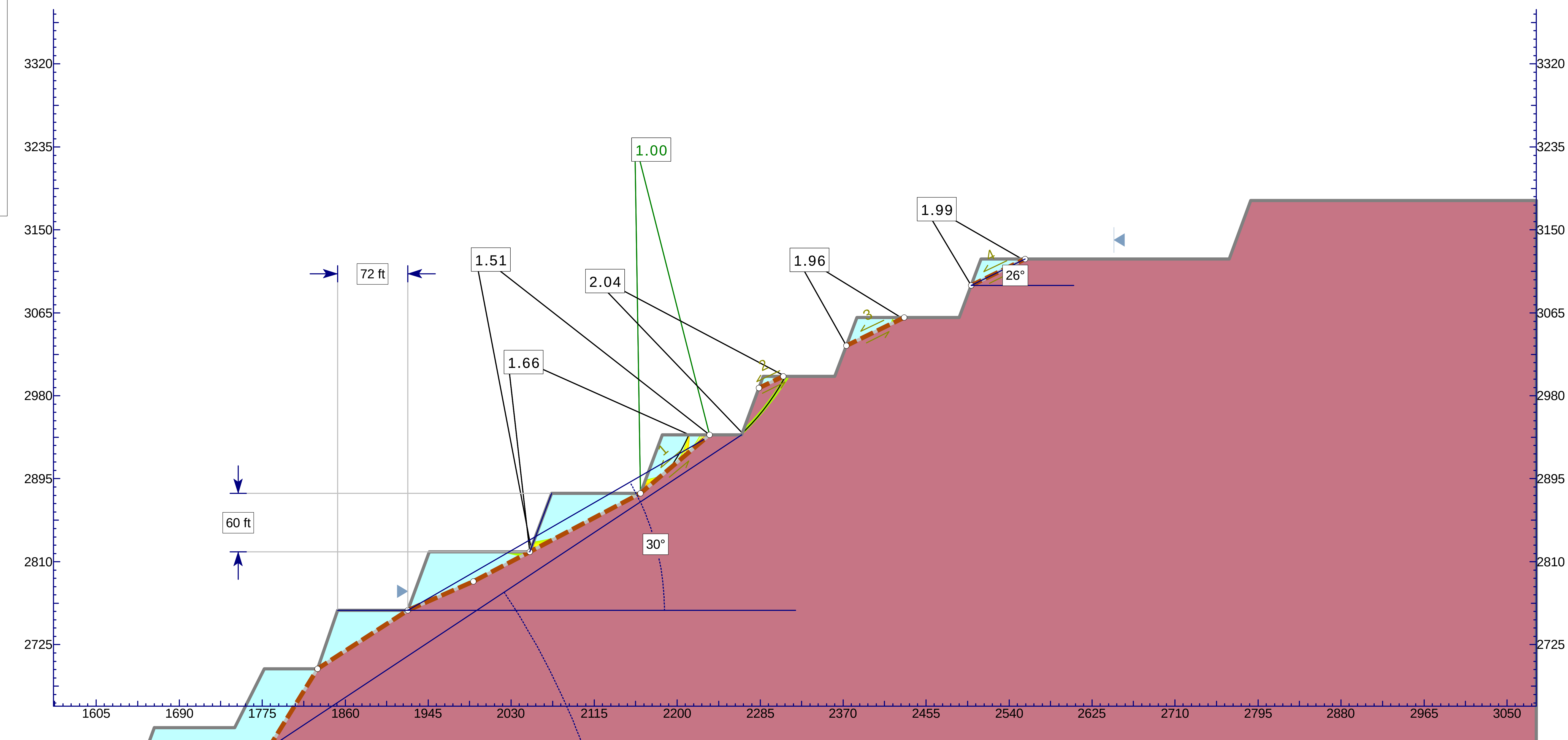
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	Section I - QTf mod whole slope
Drawn By	JMc
Company	Terracon
Date	1/28/2019, 10:03:20 AM
File Name	section I.slmd

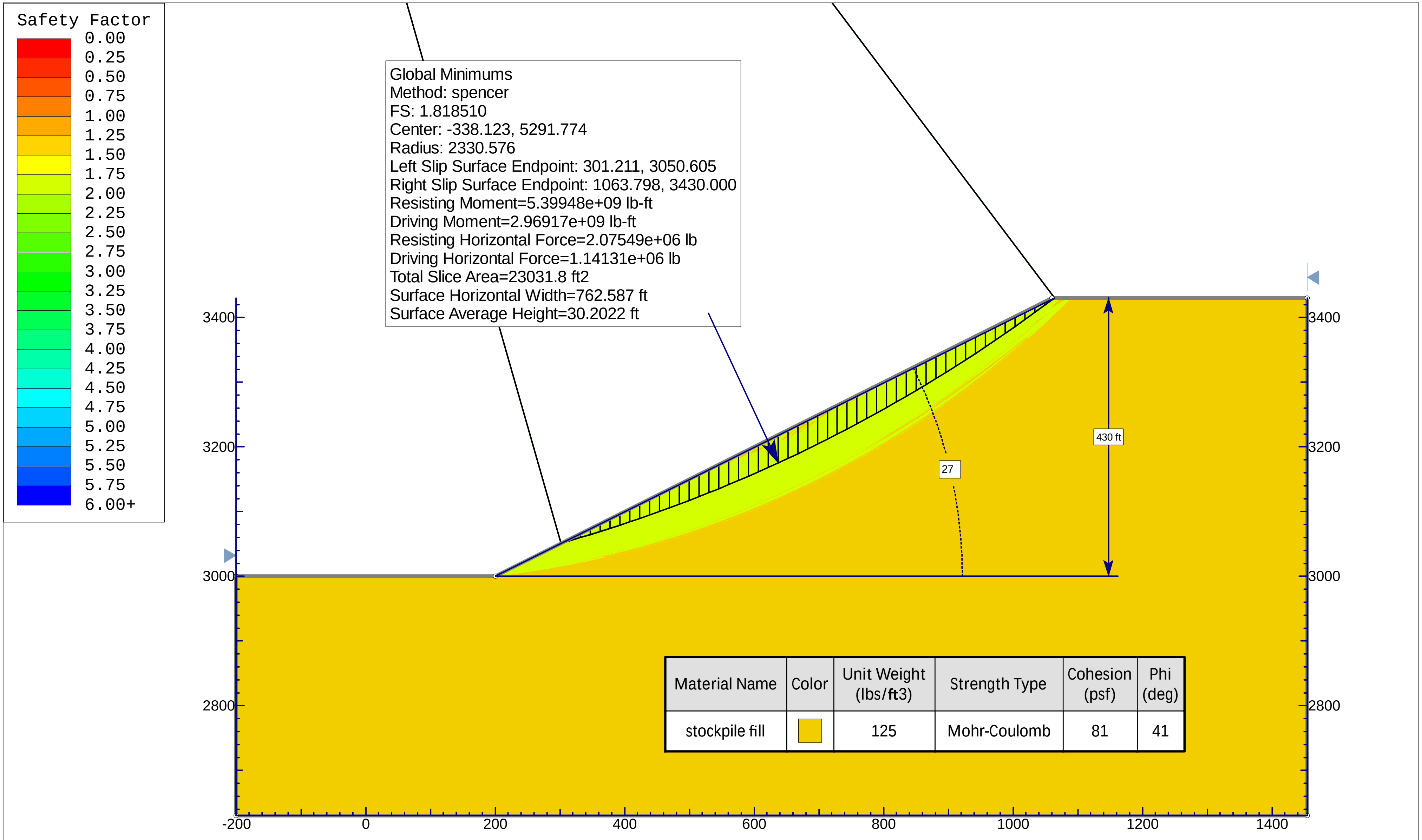


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
limestone		170	Generalized Hoek-Brown			1.87e+06	50	10	1
Sidewinder Volcanics		164	Generalized Hoek-Brown			1.5e+06	37	25	1
shear zone		120	Mohr-Coulomb	300	35				



Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	Section I - LS blocks on Js		
Drawn By	JMc	Company	Terracon
Date	1/28/2019, 10:03:20 AM	File Name	section I weak layer.slmd

SLIDEINTERPRET 8.021



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
stockpile fill		125	Mohr-Coulomb	81	41

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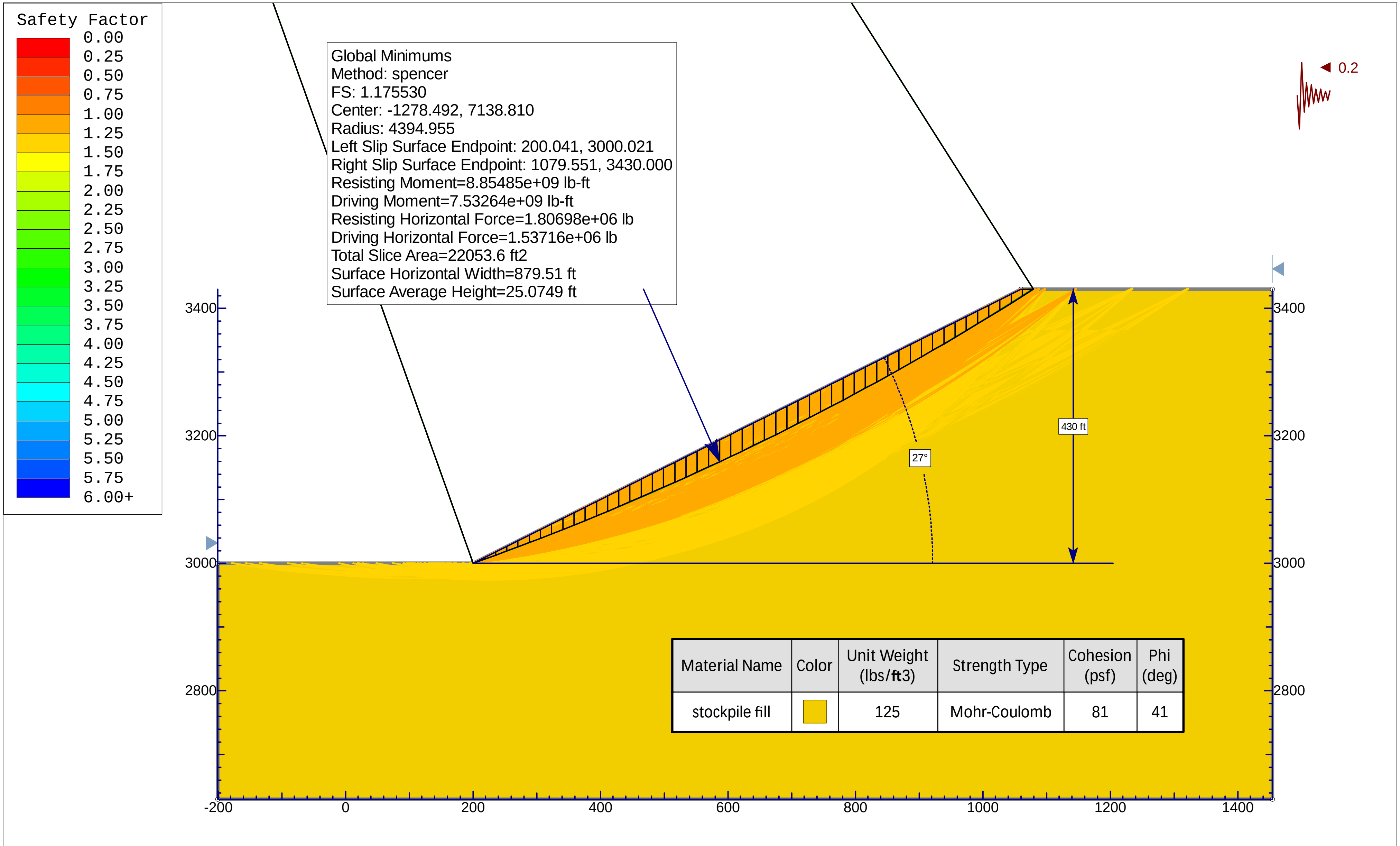
SLIDEINTERPRET 8.021

Project	CalPortland Oro Grande Amend Rec Plan
Analysis Description	OB Stockpile Fill
Drawn By JMc	*Company* Terracon
Date 1/28/2019, 1:46:55 PM	*File Name* Fill slope 430H.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
stockpile fill		125	Mohr-Coulomb	81	41

Project	CalPortland Oro Grande Amend Rec Plan		
Analysis Description	OB Stockpile Fill		
Drawn By	JMc	*Company*	Terracon
Date	1/28/2019, 1:46:55 PM	*File Name*	Fill slope 430H.slmd

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